







POPULAR
MECHANICS
DO-IT-YOURSELF
ENCYCLOPEDIA

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POPULAR MECHANICS DO-IT-YOURSELF ENCYCLOPEDIA

FOR
HOME OWNER, CRAFTSMAN
AND HOBBYIST
IN TWELVE VOLUMES



Volume III

Complete Index in Volume XII

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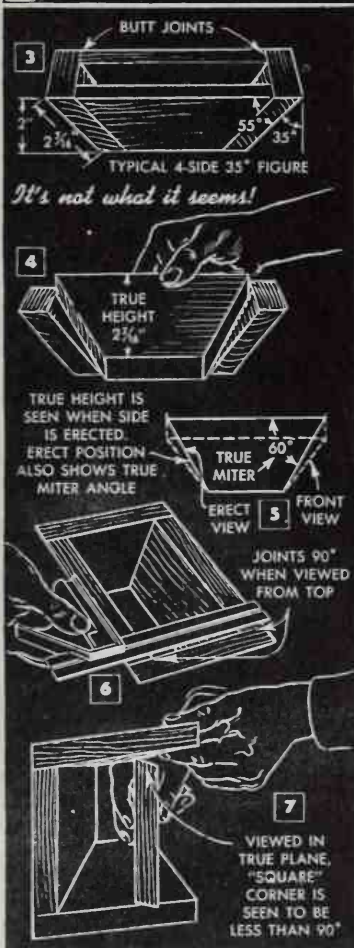
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1 PICTURE FRAME IS 4-SIDE MITER AT 45°



2 TRAY TABLE TOP LEANS OUTWARD AT 25° ANGLE

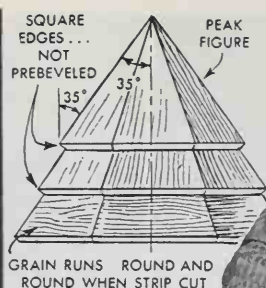


COMPOUND CUTS

IN MAKING a compound cut with a circular saw a miter and a bevel are cut in the same operation. The compound-angle cut is required when sawing the parts of any box or open framework having sloping sides. Typical examples of this type of joinery are shown in Figs. 1, 2 and 8. The angles do not show on an ordinary plan drawing and, even when you examine a finished job, the angles are not what they seem.

Laying out: As viewed from the front, the simple box in Fig. 3 is 2 in. high and the sides seem to be 35 deg. from vertical. Joints appear to be cut at a 90-deg. angle, but a study of Figs. 4 to 7 will show that you could not cut a compound corner joint, or "hopper" joint as it is sometimes called, by following these measurements. The true height of the box sides is 2 1/4 in. and not 2 in. The miter angle is 60 deg. instead of 55 deg. What appears to be a square butt joint is cut at 70 1/2 deg. instead of 90 deg. These angles are determined simply by consulting a table, Fig. 23, which gives the required tilt of the saw table and the swing of the miter gauge in degrees for sawing a number of common compound angles. The example, Fig. 3, is a butt-joint job with the sides slanting at 35 deg. The table, Fig. 23, shows that the saw table must be tilted 19 1/2 deg. and the miter gauge set to 60 1/4 deg. to produce the joint.

Sawing the parts: The parts for a box or frame can be cut from several individual pieces or continuously from one board. Strip cutting is nearly always preferred as it is simple and saves material. Fig. 9 shows the lower course of a birdhouse roof being cut from a single strip, the board being simply turned over for alternate cuts. All parts of such a structure as the birdhouse roof, Fig. 10, must be cut



8-SIDES, 35° MITER TAKES 18½° TILT AND 76½° AT MITER GAUGE

at the same setting. Figs. 11 and 12 show how the miter gauge is used when the pieces are individually cut. Note that the gauge remains at the same setting but is reversed, that is, turned around and used backwards, for the second cut in order to support the wide side of the work against the miter-gauge facing. In this case, the saw is a tilting-arbor type, the blade tilting to the right. To clarify this alternate use of the miter gauge, two sets of details are given in Fig. 13.

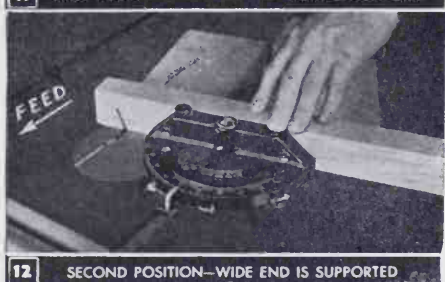
Miter-gauge positions: The right-hand details in Fig. 13 are for a tilting-arbor saw with the blade tilting to the right. The left-hand diagrams are for tilting-table saws or tilting-arbor saws on which the blade tilts to the left. Although the details are identical, they are lettered differently to correspond to instructions in the notes. The four standard positions are common to all miter cuts and the two sets of positions, A and B, and C and D, are pairs worked by shifting the miter gauge from one table groove to the other. Use any of the four positions shown for strip work or large individual pieces. In some instances, it will be necessary to use definite miter-gauge positions instead of using any of the four regular positions at will. A common limitation of this kind is caused by the use of pre-beveled boards. The boards are beveled, of course, to make the bottom and top edges of the box flat. As an example, the box sides shown in Fig. 3 are beveled at 35 deg., which is the same as that specified for the inclination of the sides. The details in Fig.



10 ALL PARTS ARE CUT AT SAME SETTING



11 FIRST POSITION FOR PEAK OR SHORT BASE WORK



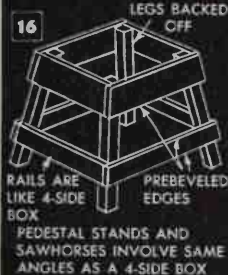
12 SECOND POSITION—WIDE END IS SUPPORTED



OVERLAPPING ASSEMBLY OF BUTT JOINTS MAKES A SQUARE FIGURE WITH SAME SIZE PIECES

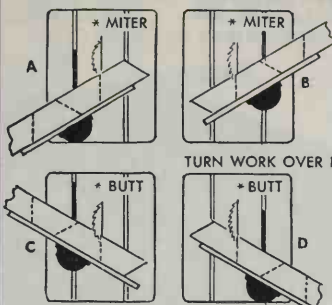


FENCE-POST TOPS COME TO A PERFECT PEAK IF JOINTS ARE MITERED. ANGLE IS 35° OR 40°

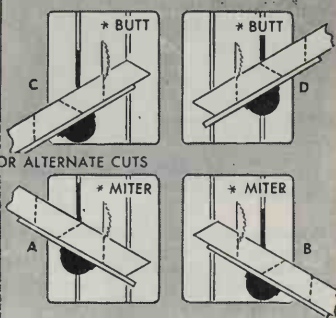


13 MITER-GAUGE POSITIONS FOR COMPOUND CUTS

POSITIONS FOR TILTING TABLE SAWS OR LEFT-TILTING ARBOR

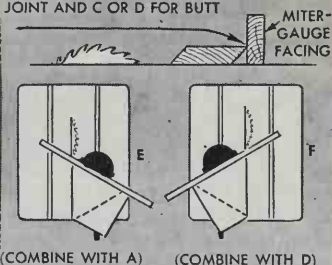
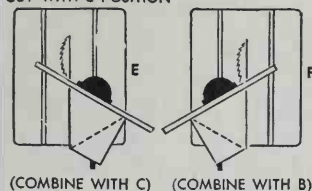


POSITIONS FOR TILTING-ARBOR SAW WITH RIGHT-HAND TILT



Four Standard Positions... USE ANY POSITION FOR STRIP WORK OR LARGE INDIVIDUAL PIECES NOT PREBEVELED. IF EDGES ARE PREBEVELED, USE POSITION A OR B FOR MITER JOINT AND C OR D FOR BUTT JOINT... THIS KEEPS BEVELED EDGE UP

MAKE SECOND CUT WITH C POSITION

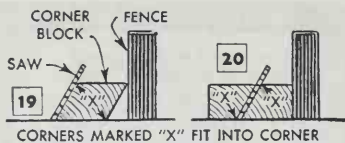
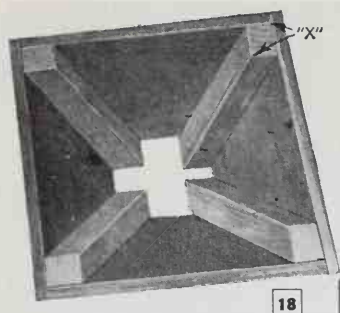


Two Special Positions... ARE USED FOR PEAK OR SHORT BASE WORK. EITHER OF THESE POSITIONS WILL KEEP WIDE SIDE OF WORK AGAINST MITER GAUGE. IF WORK IS PREBEVELED, THE BEVEL WILL BE UP FOR ONE CUT BUT DOWN FOR THE OTHER.

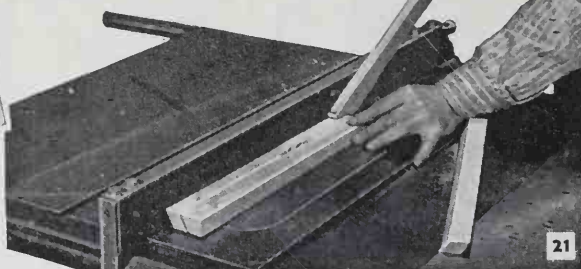


17 TILTED TABLE LEGS UP TO 10° ANGLE ARE USUALLY WORKED "IN THE SQUARE" AND WITH TOPS AND BOTTOMS CUT AT TILT AND MITER GAUGE SETTINGS EQUAL TO SAME ANGLE AS WORK. JOBS REQUIRING OVER 10° TILT SHOULD BE BACKED OFF AND OTHERWISE TREATED THE SAME AS A CORNER BLOCK.

13 show that only two of the four positions can be used for prebeveled work, that is, if the corner of the bevel is to bear against the miter gauge with the sharp corner up. Another limitation will turn up when cutting parts from individual boards to form a peak. In this instance, the work has only one base and this must be held against the miter-gauge facing for both cuts. In this case, either the E or F position, Fig. 13, may be used. When a peak is to be cut from individual prebeveled boards, the long side of the work must be held against the miter-gauge facing for both cuts, and the bevel must be up for both cuts. On a tilting-table saw, use positions B and E, Fig. 13, if the joints are mitered, or C and F if the joints are butted. On a right-hand tilting-arbor saw the positions are A and F for a miter joint and D and E for a butt joint. These combinations permit the gauge to be used on the same table groove but require a swing of the gauge from one side to the other as the alternate cuts are made. Although the instructions may seem complicated, they actually are quite simple if you just forget those which do not apply to your type of saw and refer only to the six positions in Fig. 13 which apply to your particular type of machine.



18
CORNER BLOCKS ARE BEVEL-RIPPED AT SAME SAW TILT REQUIRED FOR 4-SIDE BUTT JOINT (SEE TABLE BELOW). IF PIECE DOES NOT SHOW, ONE EDGE CAN BE LEFT SQUARE, AS SHOWN IN FIG. 20



Corner blocks: Corner blocks are often required to stiffen the joints of a box such as that shown in Figs. 14 and 18. Simply bevel-rip the material with the blade tilted to the same angle as that required for a four-sided, butt-joined box, Fig. 23. Fig. 21 shows the operation. The second bevel cut is run as in Fig. 19. If the blocks do not show in the finished work, a single ripping cut will make two corner blocks, Fig. 20. Top and bottom ends of the blocks are cut as in Fig. 22. The miter-gauge setting is taken from the table but the tilt of the saw table remains the same as when making the ripping cuts.



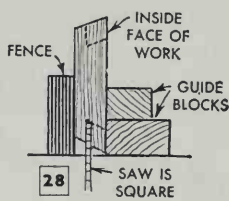
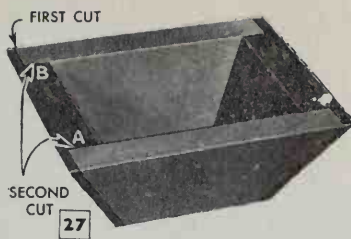
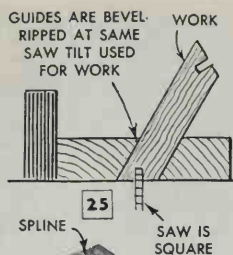
TOPS AND BOTTOMS OF CORNER BLOCKS ARE CUT WITH MITER-GAUGE SETTING FROM TABLE. SAW TILT IS SAME AS WORK ANGLE. (NOT TAKEN FROM TABLE)

Pedestal stand: Any structure with splayed legs such as a pedestal stand, lamp table or

23 TILT AND MITER-GAUGE SETTINGS FOR COMPOUND ANGLES

Work Angle	Tilt Table	Miter Gauge	Tilt Table	Miter Gauge	Tilt Table	Miter Gauge	Tilt Table	Miter Gauge
5°	1/2	85	44 3/4	85	29 3/4	87 1/2	22 1/4	88
10°	1 1/2	80 1/4	44 1/4	80 1/4	29 1/2	84 1/2	22	86
15°	3 3/4	75 1/2	43 1/4	75 1/2	29	81 3/4	21 1/2	84
20°	6 1/4	71	42	71	28 1/4	79	21	82
25°	10	67	40	67	27 1/4	76 1/2	20 1/4	80
30°	14 1/2	63 1/2	37 3/4	63 1/2	26	74	19 1/4	78 1/4
35°	19 1/2	60 1/4	35 1/4	60 1/4	24 1/2	71 3/4	18 1/4	76 3/4
40°	24 1/2	57 1/4	32 3/4	57 1/4	22 3/4	69 3/4	17	75
45°	30	54 3/4	30	54 3/4	21	67 3/4	15 3/4	73 3/4
50°	36	52 1/2	27	52 1/2	19	66 1/4	14 1/4	72 1/2
55°	42	50 3/4	24	50 3/4	16 3/4	64 3/4	12 3/4	71 1/4
60°	48	49	21	49	14 1/2	63 1/2	11	70 1/4

FIGURES ARE IN DEGREES AND ARE FOR DIRECT SETTING TO TILT SCALE AND MITER GAUGE. SCALE PROVIDING TILT STARTS AT 0° AND MITER GAUGE AT 90° IN NORMAL POSITION.



RABBETED JOINT—FIRST CUT

COMPOUND MITER JOINT IS EASILY ASSEMBLED WITH USE OF SPLINE



RABBET—SECOND CUT, END A

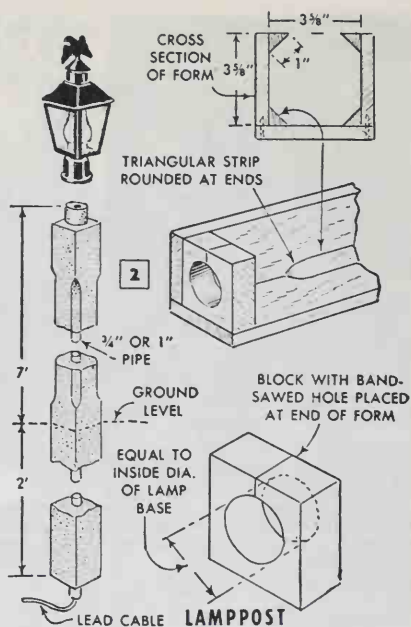


RABBET—SECOND CUT, END B

sawhorse, is worked out at the same angles as a box figure of the same general dimensions. Figs. 16 and 17 are typical examples of this type of work. A common procedure in making a pedestal like that in Fig. 16 is to make the rails first and assemble them. Then back off the legs on two opposite sides and make the angle cuts at the top and bottom ends of the legs. On the simple pedestal shown in Fig. 16, an average slope of the legs would be 15 deg. Taking this as the basic angle, you will see by referring to Fig. 23 and to the work itself that the rails are prebeveled 15 deg. The compound setting for the rails would be made by tilting the saw table $3\frac{3}{4}$ deg. and the miter gauge $75\frac{1}{2}$ deg. The legs would be backed-off $3\frac{3}{4}$ deg., and the top and bottom ends cut with a $75\frac{1}{2}$ -deg. miter-gauge setting and a 15-deg. saw-table tilt.

Types of joints: Rough work assembled with compound joints usually is simply butted and nailed. Screws and glue can be used where greater strength is required, but the finer work, such as the picture frame in Fig. 1, the birdhouse roof in Fig. 8,

and jobs like those in Figs. 15 and 26, require a plain mitered joint or a mitered joint fitted with a spline. Run the spline grooves as in Figs. 24 and 25, using the simple fixture in the manner pictured. Rabbeted joints are cut in two passes, the first cut being from the end of the work as in Figs. 28 and 29. The second cut parallels the end surface and is made at the same tilt and miter-gauge settings as were used in cutting the joint. Limitations are that the inside surface of the work must be down and the wide end of the work must bear against the miter-gauge facing. If the piece is small, the gauge must be swung to the opposite side and it must be used backward when making one of the cuts. Fig. 30 shows the end A, Fig. 27, being cut in the conventional position. Fig. 31 shows the same cut on end B being made with the gauge reversed. Always use a sharp saw blade with a medium set for all bevel cuts.



CONCRETE IMPROVEMENTS

WHEN PERMANENCE is the main requirement in exterior home improvements such as lampposts, steps and fireplaces, it's generally more practical to use concrete. This common building material can be mixed in attractive permanent colors, is rot, fire and termite-proof and, when properly mixed and poured according to approved specifications, will withstand weathering and extremes of temperature over long periods of time without damage. It also has a decided advantage in economy and ease of handling. Homeowners without any previous experience in working with concrete can tackle many jobs single-handed with assurance of good results right from the start.

Lamppost: A concrete lamppost of the kind shown in Figs. 1 and 2 is cast in a three-sided form. If you use lumber with a pronounced grain for the form, the wood grain will be imprinted attractively in the concrete post. Chamfered corners are formed on the post by triangular strips rounded at the ends and nailed to the inside corners of the form as in Fig. 2. The post should extend into the ground below the normal frost level. If the lamp has a round, hollow base, the upper end of the post is cast round to fit it by nailing a wood-

en block in the end of the form. A hole is bandsawed in the block, its diameter being slightly less than the inside diameter of the lamp base. The hole forms a boss on the top end of the post. A length of pipe supported at each end of the form serves the double purpose of reinforcing the concrete and providing an opening for the wiring. White cement often is used for this job so it will not be necessary to paint the post. Use a mix of 1 part cement, $2\frac{1}{4}$ parts sharp sand and $2\frac{1}{2}$ parts of gravel screened to $\frac{1}{2}$ in. in dia. Add sufficient clear water to make a smooth mixture. Work the concrete into contact with every part of the form, especially at corners, to avoid air pockets.

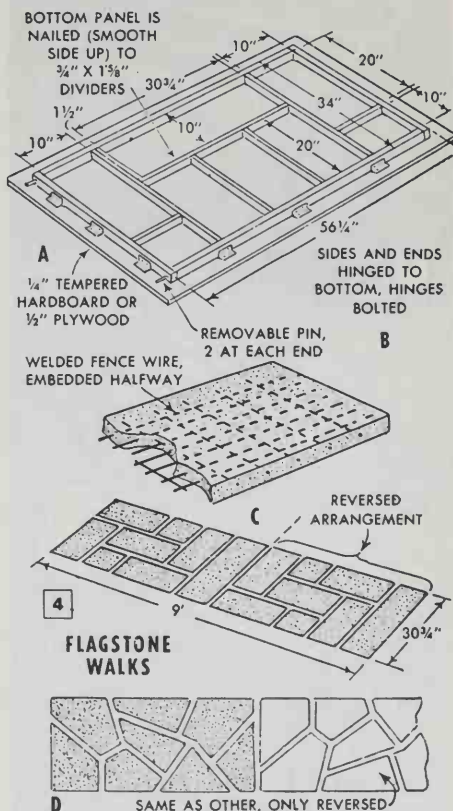
Concrete flagstones: Precast concrete flagstones, Figs. 3 and 4, need be made only $1\frac{1}{8}$ in. thick if they are reinforced with welded fence wire as in Fig. 4, B. Build the form as in detail A. Note that the sides and ends are hinged so they can be swung outward to remove the slabs easily after they have hardened for two or three days. The form shown produces enough flagstones to lay a $4\frac{1}{2}$ -ft. section of walk about 30 in. wide, arranged as in detail C, each alternate section being reversed. Such irregular patterns as the one in detail D also are possible. The form shown in Fig. 4, A, requires nearly $1\frac{1}{2}$ cu. ft. of concrete to fill it. A

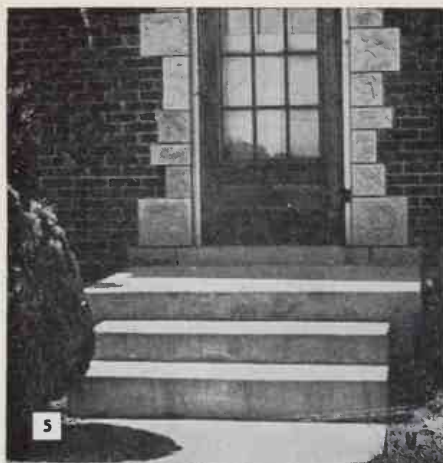


Around the HOME

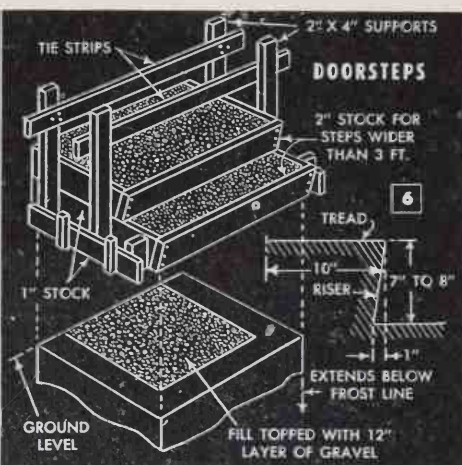
1: $2\frac{1}{4}$: $2\frac{1}{2}$ mix is recommended, with the gravel screened to $\frac{1}{2}$ in. in dia. Flagstones can be cast with colored concrete if desired. Brush the forms liberally with oil, clean them after each casting is removed, and re-oil before using again. Cut the reinforcing wire with a heavy-duty cutter so that each piece is slightly smaller than the slab. After filling the form half full, press the wire in place, then fill to the top and strike off level.

Concrete steps: For permanence, build steps on a 6-in. foundation wall extending below the local frost level, Figs. 5 and 6. In sandy soil a double form is needed, but where soil is stiff enough to resist caving, an inner form usually is sufficient. After the foundation has hardened, fill the hole, tamp the gravel fill and build the form for the steps. Note that tie strips are located well above the edges of the form boards to allow room for finishing the concrete with trowel and edger. Treads should be 10 to 11 in. wide and the step height 7 to 8 in. Slanting the risers inward 1 in. at the bottom provides added toe space. In this case the edges of the riser forms should be planed at an angle to fit flush with the tread surfaces. If one riser must be of slightly less height than the others, it should always be located at the bottom for maximum safety. If you notice that the first tread bulges up when concrete is poured to the second

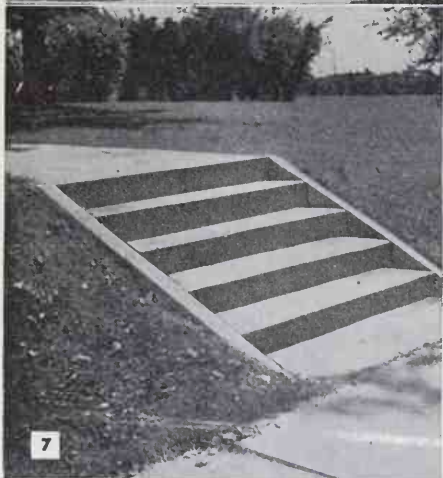




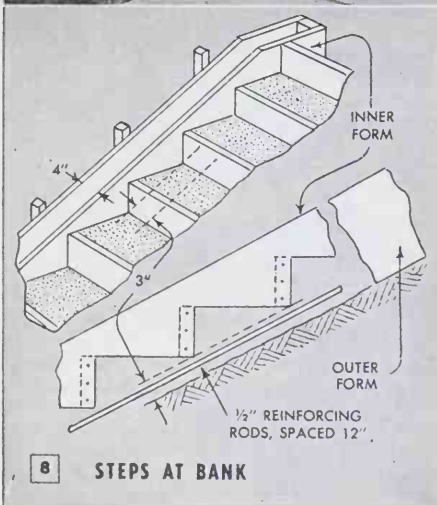
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6



7



8

STEPS AT BANK

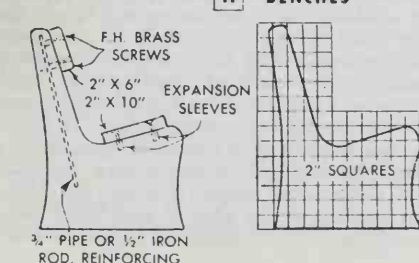
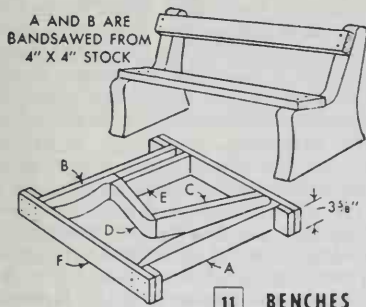
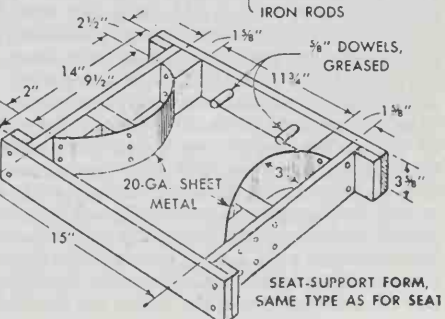
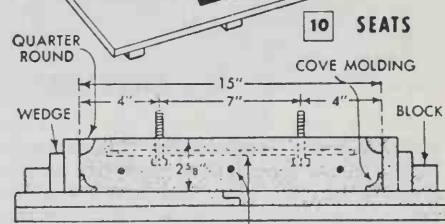
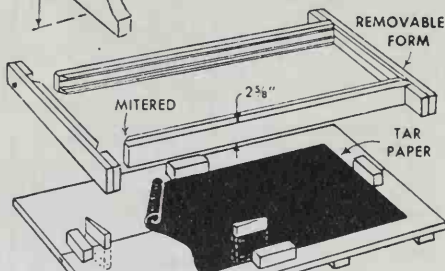
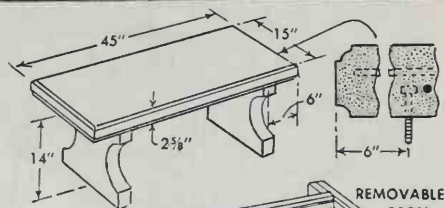
tread level, the mix is not stiff enough. To avoid trouble let the concrete of each tread level set several hours; mix a new batch for each step. Round the edges of the treads with an edger after finishing with a trowel or float. Steps on a bank, Figs. 7 and 8, should have side walls made by using a double form. The earth should be excavated below the treads to produce a continuous slab 3 or 4 in. thick, which is reinforced with $\frac{1}{2}$ -in. rods. A mix of 1: $2\frac{1}{4}$: 3 is recommended for steps, the gravel being screened to $\frac{1}{2}$ in. in size.

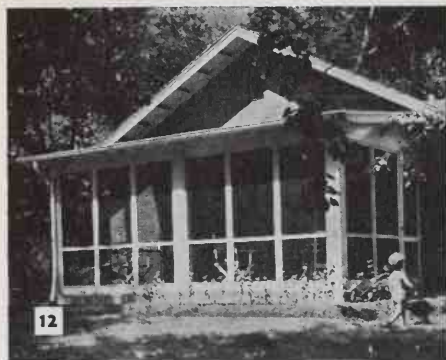
Garden seats: Garden seats of the type shown in Figs. 9 and 10 consist of a reinforced concrete seat slab laid on two supports. Reinforce the seat with iron rods or welded fence wire. Cast the seat in the inverted position so that you can embed bolts by holding them in place with crosspieces nailed to the sides of the form about 6 in. from the ends. To form neat edges on the seat, nail $\frac{3}{4}$ -in. quarter-round and cove molding to the inside of the form as in Fig. 10. A piece of tar paper laid on the bottom of the form made up of boards will provide a smooth surface and prevent imprinting of the wood grain. Brush oil on the forms before pouring concrete. Note how the sides of the form are held from spreading at the ends by cleats on the end forms, and how blocks and wedges are used to hold the form in position. The embedded bolts in the seat fit correspondingly spaced holes cast in the supports by means of greased dowels driven through holes in the form. The bolts are screwed into expansion sleeves. The form for the supports is made in the same way as the seat form except that sheet metal is used to form the curved edges. Use a 1: $2\frac{1}{4}$: $2\frac{1}{2}$ mix with gravel screened to $\frac{1}{2}$ in. in dia. Trowel the concrete against the edges and into the cor-

ners of the form before it has been completely filled. Although the castings can be removed from the forms in two or three days, keep them covered with wet grass clippings or straw for a week to ten days before assembling. In the meantime pour the footings for the seat supports in the desired location in the garden. If you prefer a bench having a wooden seat and backrest on concrete supports, or endpieces, follow the design shown in Fig. 11.

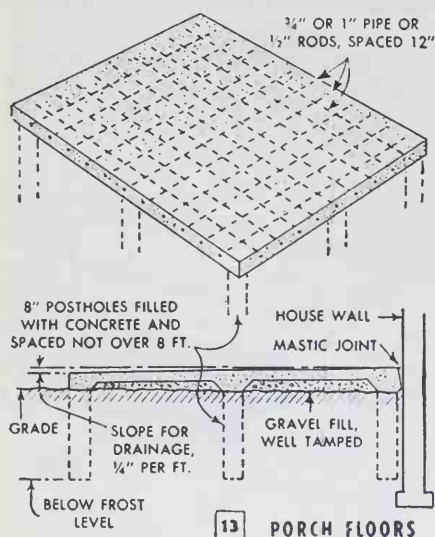
Porch floors: Perhaps you have been planning a screened porch with a concrete floor, such as the one in Fig. 12. Concrete porch floors laid on newly graded soil or raised slightly above grade should be supported on concrete piers extending to well-compacted soil below the frost level as in Fig. 13. If the soil is heavy, the holes for the piers can be dug with a posthole auger, but if sandy, use sheet-metal furnace pipe for forms. Build the edge forms so the floor will slope $\frac{1}{4}$ in. per foot for drainage. Then fill the space below the floor with tamped gravel and pour the concrete, using a 1: $2\frac{1}{4}$: 3 mix. Reinforce in two directions with iron rods. Reinforcing is necessary since most of the floor weight will be carried on the piers. A mastic joint between the porch floor and the house wall allows for slight expansion and contraction without breaking the seal. You can use mastic strips or you can insert a wedge-shaped form board between the wall and the slab to leave a space to be filled later with oakum and roofing cement or hot asphalt.

Birdbath: Figs. 14 and 15 show a concrete birdbath having an attractive fluted





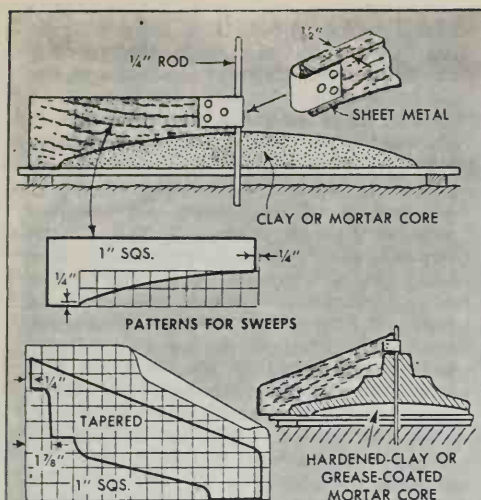
Concrete porch floors laid over new earth fill are supported on concrete piers extending below frost level. Holes for piers are dug with posthole auger



pedestal and a molded base. This design is intended for permanent location as the pedestal extends below the frost level. The bowl is cast with a tapered boss, or lug, which fits into a tapered hole in the top of the pedestal. The inside contour of the bowl is formed with a clay or mortar core, made as in the upper detail in Fig. 15, using a pivoted sweep bandsawed to the proper curvature. A sheet-metal strap nailed to the end of the sweep slips over a rod projecting through the platform and into the ground. The bottom of the bowl is formed with a sweep in the same manner. The clay core should be thoroughly dry and must be coated with heavy oil before forming the bowl over it. The end blocks of the pedestal form are split turnings and the flutes are formed

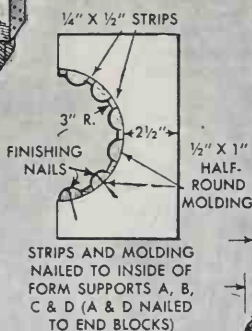
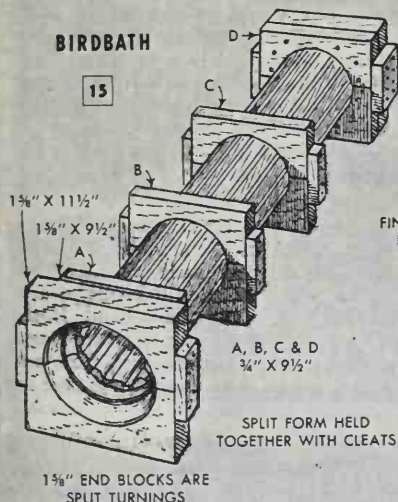
by alternate straight and half-round strips nailed to square blocks, which are first cut in half and a semicircular cut bandsawed in one edge of each piece on a 6-in. radius to form a round opening when the two halves are assembled. Level the form over a posthole dug in the desired location. For sandy soil use a length of 8-in. furnace pipe for the form below grade. This section of the pedestal should extend below local frost levels. For reinforcing the pedestal, center a length of 1-in. pipe in the hole. Four $\frac{1}{4}$ -in. iron rods placed near the edges of the form also can be used. Use a 1: $2\frac{1}{4}$: $2\frac{1}{2}$ mix, with gravel not over $\frac{1}{2}$ in. in dia. for that part of the pedestal below grade. Use only cement mortar (1 part cement to 3 parts sand) to form the molded section, tamping it to assure contact with the form. Then continue with the concrete mix, but resort to cement mortar again at the top turning. The hole at the top of the pedestal is formed by a greased wooden turning which is slightly tapered. Embed a 6-in.-wide band of welded fence wire in the mortar around the hole.

Vases and urns: You can make attractive vases and urns, Figs. 16 and 17, from cement mortar without using molds by applying the mortar in successive layers to expanded metal lath held on a removable form. After determining the size and design of the vase, Fig. 17, make a full-size pattern of it on heavy paper. Allow $1\frac{1}{8}$ in. for wall thickness and mark this off on the pattern so that you can determine the width of the stock for the ribs. Bandsaw the ribs to identical curvature and also bandsaw three disks, two for the top and one for the bottom. After assembling the form, drill center holes for $\frac{1}{2}$ -in. pipe. Then cover the form, including the bottom, with metal lath. Don't attach the lath to the form with nails or staples as it must be removed. Next, make the platform on which the inverted form is rotated while applying the mortar. A sturdy template, or sweep, is firmly mounted on the platform to serve as a guide for applying mortar and also as a support for the $\frac{1}{2}$ -in. pipe. A suitable mortar is made by dry-mixing (by volume) 1 part portland cement, 3 parts sharp sand and $\frac{1}{10}$ part hydrated lime. Add water to make a rather stiff mixture and let it stand for an hour or so before using. Apply the mortar in three successive $\frac{3}{8}$ -in. coats, one full day apart. The first coat should anchor securely to the lath and just cover it. Don't trowel the surface smooth as the next coat will key better to a rough surface. To check on the thickness of the first coat, hold a small $\frac{3}{4}$ -in. block between the template and the mortar while rotating the form. Application of the second and third coats is similar. Before applying these, wet the

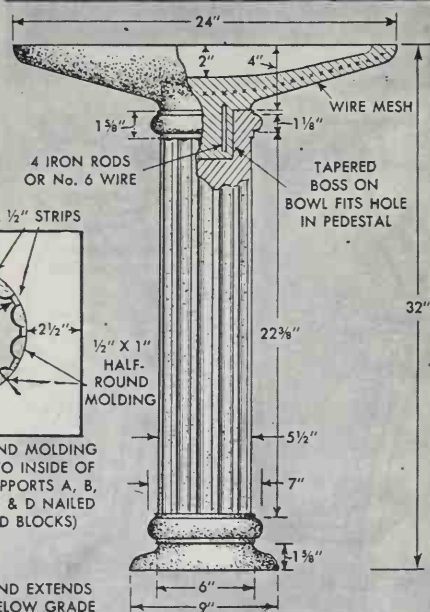


BIRDBATH

15



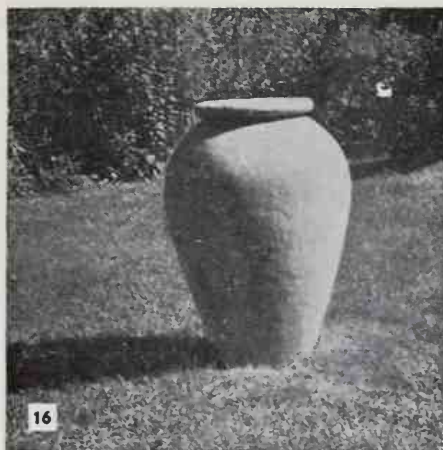
END EXTENDS BELOW GRADE



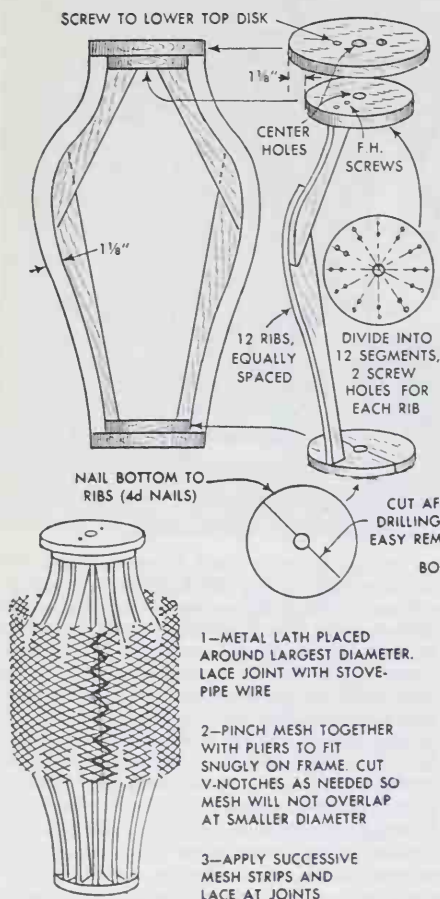
previous coats thoroughly. The last coat is trued by rotating the form against the stationary sweep which has a beveled edge to produce a smooth finish. After the mortar has hardened so it resists marking, wrap the vase in several layers of burlap and keep this wet for a week. Slow curing of the mortar gives it maximum strength. Then remove the base from the platform and unscrew the two disks at the top, after which the ribs can be pulled out easily. If the bottom disk is swollen from moisture, wait until it dries and shrinks before attempting to dislodge each half with a punch inserted through the hole in the bottom of the vase. This hole is filled with mortar when finishing the inside of the neck.

Trash burner and fireplace: To eliminate

an unsightly wire trash burner, substitute one of concrete, Fig. 19, A. First pour a 6-in. concrete slab, reinforcing it with 1/4-in. iron rods or pipe. The form for the slab is shown in detail B. It should be about 4 in. larger each way than the burner and should be flush with the grade so that the grass edging can be cut with a lawn mower. The burner forms, detail C, are built with sheathing board or plywood and are cleated with 1 x 2 and 2 x 4-in. stock. A rectangular box-type form is fitted between the inner and outer forms to produce the draft opening. It also serves to hold the inner form in position while the concrete is being poured. The inside form is cleated on the inside corners, and similar cleats are nailed on the outside of the outer forms, with adjacent sides



16



NAIL BOTTOM TO RIBS (4d NAILS)

CUT AFTER DRILLING FOR EASY REMOVAL

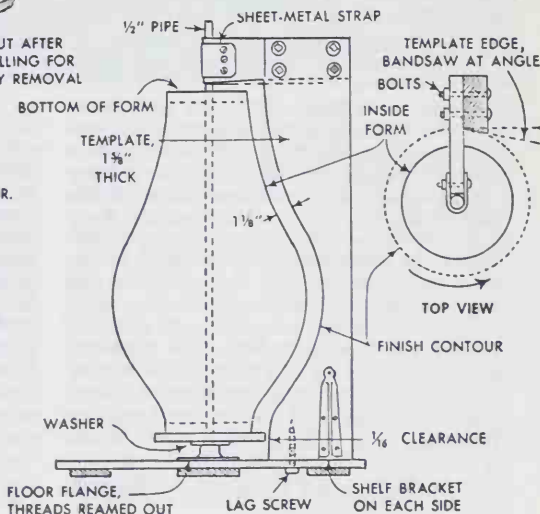
1—METAL LATH PLACED AROUND LARGEST DIAMETER. LACE JOINT WITH STOVE-PIPE WIRE

2—PINCH MESH TOGETHER WITH PLIERS TO FIT SNUGLY ON FRAME. CUT V-NOTCHES AS NEEDED SO MESH WILL NOT OVERLAP AT SMALLER DIAMETER

3—APPLY SUCCESSIVE MESH STRIPS AND LACE AT JOINTS

nailed to them, one from the inside and the other from the outside. Only a single support placed edgewise is needed on each side of the outer form. These supports are held by tie strips at the top, and braces and stakes at the bottom. A similar procedure is followed in making a charcoal-burning fireplace, Figs. 18 and 19, D. If desired, this can be used as a trash burner. Four bolts or 6-in. lengths of $\frac{1}{2}$ -in. iron rod are embedded in the walls to support the top grate. Only two are needed for the lower grate as it rests on concrete at the front. The bolts or rods are inserted through holes bored in the form. Be sure to get them level, particularly those for the top grate. Don't use iron rods extending across the opening as expansion of the rods when heated may crack the walls. For grates you can use discarded refrigerator or stove shelves of welded construction. Or, you can make grates as in detail E. Trash burners and fireplaces should be reinforced by using welded fence wire. Use a 1: $2\frac{1}{4}$: 3 mix, with gravel not over $\frac{3}{4}$ in. in dia. Where heaving frosts are likely to tilt the slab, the foundation walls should extend below the local frost level. Don't light a fire until after the concrete has cured for two weeks, during which time it should be kept moist by covering with burlap sacks and soaking them thoroughly every day.

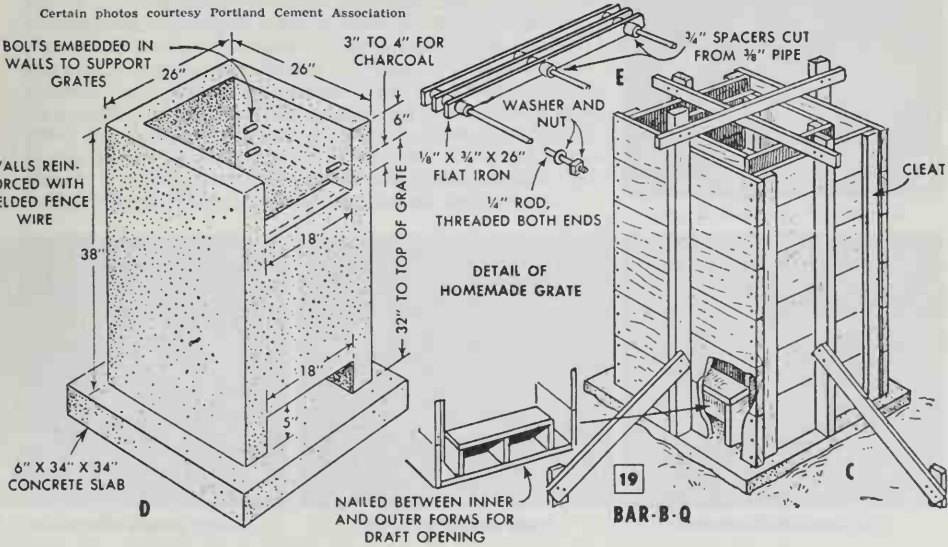
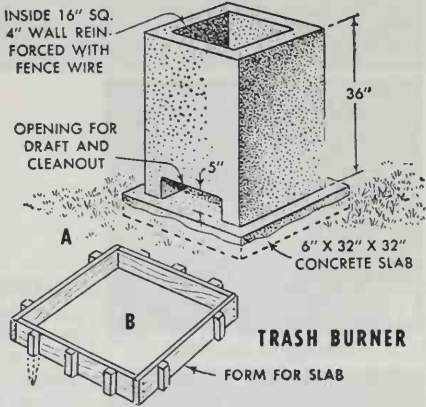
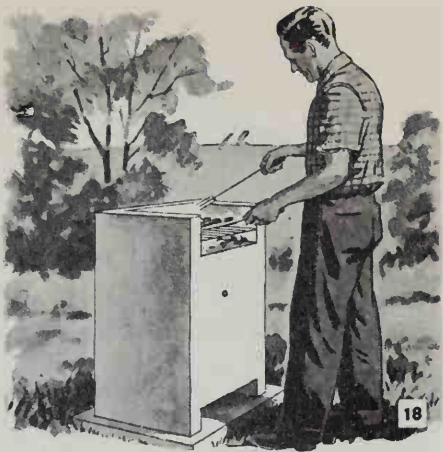
Making good concrete: One sack of portland cement contains 1 cu. ft. by volume. Proportions for dry mixes are measured by volume also, and this should be done accurately. Use only clean sharp sand. Both sand and gravel should be free from vegetable matter, clay, loam and dirt. Cement and sand are mixed first, then the gravel is

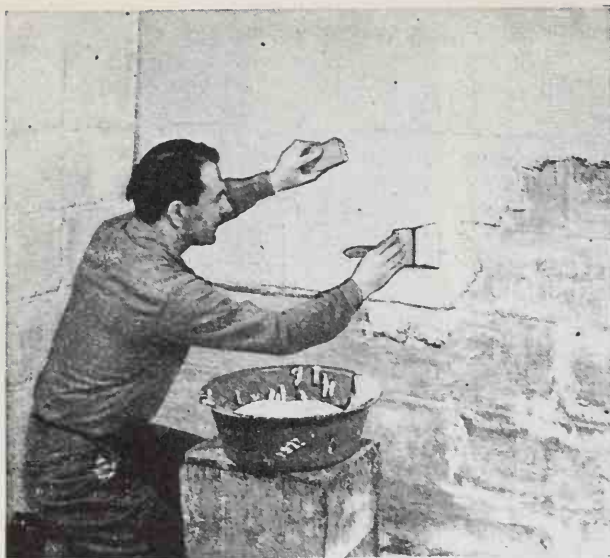


added and mixed. Proportions of mixes are given in the same order. For example, a 1: 2: 3 mix is composed of 1 part cement, 2 parts sand and 3 parts gravel. The water used for mixing concrete should be clean and the amount added after the dry aggregate has been thoroughly mixed should be just enough to produce a workable mixture. From $3\frac{3}{4}$ to $6\frac{1}{4}$ gal. of water are used for each sack of cement, or proportionally smaller quantities for less cement. The minimum amount of water will produce a mix varying from a pouring plasticity to a stiff consistency depending on the degree of moisture present in the sand and gravel. When a mix is too stiff, it will not make uniform contact in the form, resulting in air pockets and stony spots that detract from good appearance. Working the mix into contact with the forms is possible only if it is plastic enough to work easily. Concrete and mortar should be placed in forms not later than 45 minutes after mixing. Never let newly poured concrete dry out; keep it moist for a week to ten days. Large surfaces, such as porch or patio floors, can be covered with straw and loose earth. This must be kept moist by frequent sprinkling. Remember to cover not only the surface but, if the forms are removed, the edges of the slab as well. Shovel earth against the edges as soon as forms are removed.

Coloring concrete: Mineral-oxide pigment, available in several colors, is best for coloring concrete or cement mortar. It is mixed with the sand and can be used in quantities up to 10 percent of the amount of cement used in a batch to give deep shades of color. Thorough mixing after adding water also is essential. ★ ★ ★

Certain photos courtesy Portland Cement Association





Cement Paint

IS LEAST EXPENSIVE WALL FINISH BUT TAKES MORE TIME TO APPLY AND CAN ONLY BE USED FOR WORK NEVER BEFORE PAINTED. NOT SUITED FOR FLOORS. APPLY WITH A BRISTLE WALL BRUSH AND WORK IT INTO PORES OF CEMENT WITH A SCRUB BRUSH IF NECESSARY. PATCH CRACKS WITH STIFF PASTE MADE FROM THE MASONRY PAINT ITSELF

GOOD ANCHOR IS OBTAINED ON BARE CONCRETE SURFACE



POOR ANCHOR IS OBTAINED ON SURFACE PAINTED BEFORE

CONCRETE



WATER-MIX TO STIFF PASTE



MORE WATER AND HAND MIXING



STRAIN THROUGH SCREENING



SLUSH CRACKS WITH PAINT



FILL CRACKS WITH PASTE

PERFECTLY DRY concrete can be painted with almost anything. However, concrete invariably must contend with moisture—and that's a far different story. The moisture itself is bad enough, but teamed with concrete it continually releases lime which is destructive to ordinary oil paints. All good concrete paints resist this combined water and chemical action.

Cement paint: Cement paint is 85 percent cement and the rest is mostly pigment. You can buy it for 10 cents a pound and you can also pay 40 cents a pound, the difference being in the grinding. A fine-ground cement will brush and cover better than a coarse mix. However, the cheap, coarse mix is just as good where big voids must be filled. Cement paint has none of the resins or oils which make other paints stick—it depends mostly on mechanical anchorage for bonding. Hence, it is not



PAIN^TING

Rubber Base

IS IDEAL FINISH FOR ALL CONCRETE JOBS... INSIDE OR OUT... WALLS OR FLOORS. EASY TO APPLY BY BRUSH OR SPRAY. ONLY DRAWBACK IS THAT IT COSTS A BIT MORE THAN OTHER SUCH PAINTS

recommended over a surface previously painted. Even on cement paint itself, no later application is as good as the first. Because the coating is simply a thin layer of cement, this paint is much too brittle for floors.

Patching cracks: Cement paint is excellent for patching under any finish. Start by mixing a stiff paste of the cement powder, Fig. 1. Put some of this in a tumbler and thin to milk consistency. Slush this mix into cracks for a bonding coat, Fig. 4. Follow immediately with the stiff paste, Fig. 5. For cracks over $\frac{1}{4}$ in. wide, mix sand, 2 parts, with cement paint or cement, 1 part. Let the patch flat out until it does not look wet, then spray or brush with water, Fig. 6. Keep the patch wet for a couple hours; when the wet surface does not rub off, Fig. 8, the paint is cured. If you are not using a cement-paint top coat, patching can be done with other types of patching materials, including calking compound.



ROOF BRUSH IS HANDY FOR OUTDOOR PAINT APPLICATION



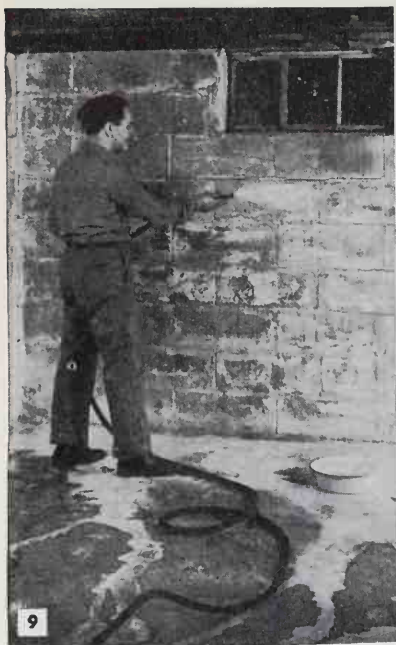
6. CURE PATCHES WITH WATER



7. KEEP THE PAINT WET



8. GIVE CURE THE RUB TEST



Old Paint

IS MESSY TO REMOVE BUT IF IT IS POWDERY OR SCALY IT'S BEST TO GET RID OF IT. PARTIAL REMOVAL IS USUALLY SUFFICIENT. USE A FIBER SCRUB BRUSH FOR AN EASY JOB



REMOVE WHITEWASH AND CALCIMINE WITH HOT WATER. USE 20-PERCENT SOLUTION MURIATIC ACID FOR WATER-RESIN PAINT



A CAN OF LYE (13 OZ.) WITH 1 GAL. HOT WATER WILL REMOVE OIL PAINT. WEAR RUBBER GLOVES. RINSE JOB WELL

Mixing cement paint: Like other hard-to-mix materials, you start by making a stiff paste, Fig. 1, adding water gradually. The best way to get out the lumps is to dig in with your hands, Fig. 2. However, cement paint is not kind to some hands, so it is best to wear rubber gloves when doing this. As an alternate or further step in getting a smooth mix, the paint can be strained through screening wire, as shown in Fig. 3.

Application: The wall must be damp to start; then, after the paint has obtained its initial set, it must be cured by further wetting. After making patches where needed, allow 24 hrs. to dry. Then, spray the entire surface with water. Let the water soak in. Spray it again until uniformly wet. Let the wall dry out so that it is not actually wet on the surface, and then start painting. This paint settles fast and should be worked from a shallow pan, dipping the brush to the bottom. On a very porous surface, application should be made with a bristle wall brush, scrubbed in immediately and thoroughly with a scrub brush, and then tipped off with the bristle brush. On an average, slightly porous surface, the scrubbing can be eliminated. On cinder block, mix equal parts of clean sand and paint powder for the first coat.

Curing cement paint: Cement paint will reach its initial set an hour or two after application—it will then lose its surface wetness and appear flat. At this stage, it should be wetted with a spray gun or fine spray from a garden hose. About two hours are needed to complete curing, and this may require just one wet or 10 wets, depending on the weather and job location. When the wet coat resists rubbing, it is cured. Allow 24 hrs. dry before recoating. Wet down before the second coating, and cure the second coat just like the first. Good curing is important, but don't rush it; paint wetted too soon is liable to scale. The other side of the situation is that if you neglect curing, the paint will be powdery when dry.

What about old paint?: Most manufacturers do not recommend cement paint over a surface previously painted. However, for a basement wall where there is no weathering problem, it is safe enough to use cement paint providing the old finish is thoroughly removed. With other paints, removal of an old coating is not so important. So long as the old paint is sound, any of the other paints will stick. Hence, wall preparation can be confined to a simple dry brushing. If whitewash or calcimine, it is usually worth while to remove the old coat at least partially. This is easily done with hot water, Fig. 10. Muriatic acid, 1 part, to water, 4 or 5 parts, is a good final cleaner for water paints and will also etch the wall, making a good base for the new paint. Oil paint is the tough stuff. Dry brushing with a power wire brush will knock it off, but you'll be eating dust for a week. One pound of lye with 1 gal. of hot water is a stock oil-paint remover, although much of its magic is pure elbow grease. Neither acid nor lye will touch old rubber-base paint, so

Rubber-Base Masonry Paint

DRIES FLAT AND IS INTENDED FOR WALL USE, NOT FOR FLOORS. CAN BE USED INSIDE OR OUT, ON BARE CONCRETE OR OVER OLD PAINT. GOOD FOR ASBESTOS SHINGLES. THE BRUSHES MUST BE CLEANED WITH SPECIAL THINNER PROVIDED

all you do is smooth down any bad spots with sandpaper. If you do any cleaning up with water, remember it takes a couple of days to dry.

Rubber-base wall paint: The best application is by brush since rubber-base masonry paint is too heavy to spray with average homeshop equipment. However, it can be sprayed if thinned with about 1 pt. of the special thinner to 1 gal. of paint. A nice feature about spraying rubber base is that it does not dust nearly as much as other paints; a poor feature is that it tends to clog the nozzle of the gun when used too thick. A second coat of rubber-base paint will soften the first coat. Therefore, while the paint dries to the touch in a couple hours, it should be allowed 24 hrs. to dry before recoating. Even then it will pick up a little if brushed too much. If you spray, you don't have to worry about the pickup. Another tip on spraying: Don't try for perfect, solid coverage; it will dry better than it looks wet. The same also applies to brushwork. Rubber-base masonry paint does not show laps—you can start and stop as you please and double-coat at will with never a single telltale mark.

Rubber-base floor paint: The floor should be



Quick Data ON 5 CONCRETE PAINTS

14 KIND OF PAINT	WHERE USED	APPLICATION	COVERAGE		GENERAL FEATURES
			FIRST COAT	SECOND COAT	
CEMENT PAINT Powder form for mixing with water. Tints and white	Any porous masonry wall surface not previously painted; brick, concrete, cement stucco, cinder block. Not for floors	Stiff-bristle brush. Wall must be damp and paint sprayed with water after obtaining its initial set. Sand is added for cinder block	10 to 15 sq. ft. per lb. 75 to 125 sq. ft. per gal. (8 lbs. powder makes 1 gal. of paint)	15 to 25 sq. ft. per lb. 125-200 sq. ft. per gal.	Inexpensive. Excellent for cinder block and very porous concrete. Dries flat. Too brittle for floors. Can be sprayed only with agitating equipment. Suitable for new work after 10 days
RUBBER-BASE FLOOR PAINT Ready-mixed. Several colors, black, white	Especially for concrete floors. Works best on bare concrete but can be used over old paint	Brush or spray. Dries in 2-4 hrs. to touch but needs 24-hr. dry for second coat or service	About 300 sq. ft. per gal. on average surface	About 400 sq. ft. per gal.	Most expensive of concrete paints. Hardens dusty floors. Dries semi-gloss. Also suitable for wood. Free flowing, easy to brush. Second coat will pick up first coat unless thoroughly dry
RUBBER-BASE MASONRY PAINT Ready-mixed. Tints and black, white	Especially for walls, inside or out, on bare concrete or over old paint	Heavier than R.B. floor paint and needs thinning for spray application. Wall must be dry. One coat covers	About 250 sq. ft. per gal.	About 350 sq. ft. per gal.	Too expensive as first coat for cinder block. Needs 24 hrs. to dry for recoat, although dry to touch in 2 hrs. Flat finish. Good for asbestos shingles
OIL-BASE MASONRY PAINT Ready-mixed. Several colors, black and white	All masonry surfaces. Also is good general paint wherever flat finish is suitable	Brush or spray. Some products require primer coat	About 250 sq. ft. per gal.	350 to 600 sq. ft. per gal.	Has tung-oil base which resists lime better than linseed oil but not as good as rubber base. May be flat or gloss depending on make. House paint with tung oil is equivalent
EXTERIOR RESIN EMULSION Paste form mixes with water. Tints and white	Bare or painted masonry inside or out except floors. Do not use where mildew is present	Brush or spray. Second coat should be applied 8-12 hrs. after first. Not proof against rain for 12 hrs.	About 300 sq. ft. per gal. of paste	400 to 450 sq. ft. per gal. of paste	Inexpensive. This is a breather-type paint and does not waterproof nor resist passage of water. Becomes translucent when wet. OK for new work after 30 days. Dries flat



Rubber-Base Paint

IS TOPS FOR FLOORS. IT HARDENS SOFT CONCRETE. ALL SOAPY OR SLICK FLOORS SHOULD BE ETCHED WITH A 10 PERCENT SOLUTION OF MURIATIC ACID. RINSE WITH WATER



EXTEND FLOOR COLOR UP WALL



WATCH OUT FOR DAMP PATCHES

dry. If it is soapy or oily, or if it has a very smooth, troweled surface, it should be etched with a 10 to 25 percent solution of muriatic acid. One gallon of this mix will etch about 100 sq. ft. Mop the acid liberally with a scrub brush or broom, scrub it just a little and let it fizz. Fifteen minutes does the job. Rinse well with water. Substitutes are Bowlene, Sani-Flush or similar products. Wet the floor with water first and then sprinkle the dry crystals. One can will do about 70 sq. ft.

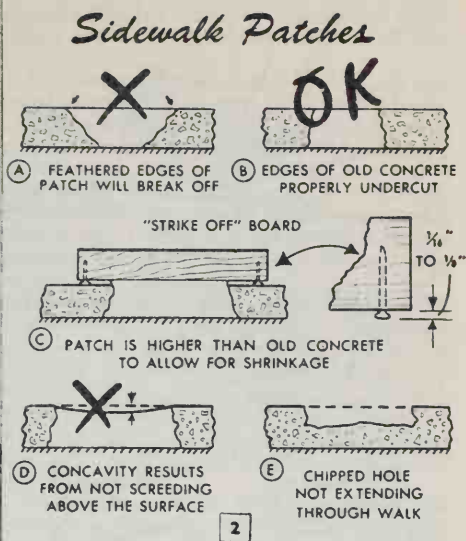
After etching or washing the floor, allow two days dry. Keep your eye on wet spots and give them an extra drying with a heat lamp, Fig. 17. Rubber-base floor paint is thinner than masonry paint and can be sprayed from a pressure-feed gun at the consistency found in the can. It has the same feature of softening undercoats as the masonry paint, and this should be remembered when doing two-color work; allow plenty of drying time, and don't brush too much when applying one color over another. A simple and practical trim is obtained by running the darker floor color about 6 in. up the wall, as shown in Fig. 16.

Oil-base masonry paint: This term covers a wide variety of paints. Generally, it indicates a paint which is very much like house paint except it is usually a flat finish and contains a good percentage of tung oil. Tung oil resists the chemical action of lime in concrete much better than linseed oil,

but not as well as rubber-base paint. On the whole, masonry paint is quite satisfactory for all outdoor work, where alkali action is less severe than in a damp basement where water and lime attack the paint film constantly from behind. Since products vary, can-label directions should be followed.

Exterior resin emulsion: If you have worked with interior water-mix paint, the exterior type will not surprise you much. You get it in paste form, mix with water, and then apply by brush or spray. This paint is not quite as good as rubber base, but if you like to paint every two or three years just for freshness, it makes an excellent, inexpensive finish.

Other products: Two other masonry-finishing materials are worth noting: hardeners and waterproofers. If your basement floor is dusting and you don't want to paint, you can obtain dry crystals or liquid hardener. The crystals mix with water; the liquid is ready to use. Both are clear finishes. Just broom the hardener on liberally and then sweep or squeegee to remove the surplus. Note that you don't need a hardener if you use rubber-base paint. The waterproofing referred to is a clear, penetrating liquid which goes deep into the masonry to make a permanent dry zone. You can paint over this waterproofing—it should not be confused with wax waterproofing which cannot be painted. Normally, most surfaces do not require this supertreatment.



CONCRETE REPAIRS

IT'S EASY to repair cracked and broken concrete walks, driveways, steps, floors and walls, or make other permanent repairs and improvements around your home with concrete.

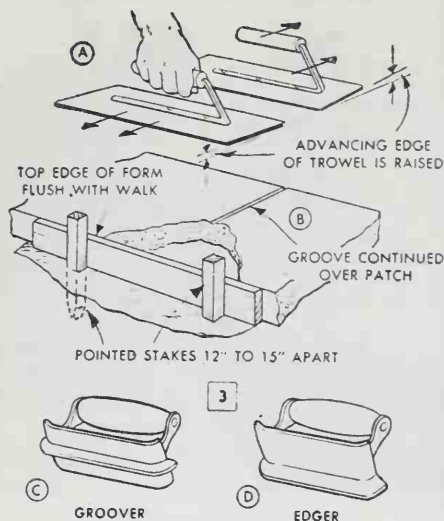
Patching sidewalks: To patch broken and crumbled portions of walks, driveways and floors, first chip away all old and crumbly concrete and undercut the edges as in detail B, Fig. 2 and Fig. 4. Always avoid featheredge joints when joining new concrete to old, detail A, Fig. 2, as such edges will break off. Use a cold chisel and hammer for chipping concrete, and protect your eyes from flying chips by wearing goggles. If the broken portion does not extend entirely through the walk, roughen the bottom and have the sides straight or undercut as in detail E, Fig. 2. Brush away all chips and dirt, and soak the edges thoroughly, Fig. 5. Then apply a coat of grout, Fig. 6. This is simply a mixture of portland cement and water, of pastelike consistency, which penetrates small voids and irregularities. Use mortar for small patches, concrete for large ones.

You can purchase prepared mortar mixes requiring only the addition of water. Concrete is made by adding gravel or crushed stone. If you mix your own mortar, use

portland cement, 1 part, and clean sharp sand, 3 parts. Mix these dry until gray color is uniform, then add just enough water to make a rather stiff mix. Small amounts can be mixed in an old pail. For concrete patches a 1:2:3 mix of portland cement, sand, and gravel, or crushed stone is recommended. Details on mixing large quantities are given in the paragraph entitled "Mixing by hand." When placing concrete in a large hole you can add washed stones.

Let the patch come about $\frac{1}{4}$ in. above adjoining surfaces. Then scrape the surface even with a strike-off board, detail C, Fig. 2. Note that this has nails projecting slightly from the underside at both ends to ride on adjoining surfaces so the patch will be slightly higher to compensate for shrinkage. For large patches, the height should be slightly more than for small patches. This method of surfacing or screeding prevents the patch becoming slightly concave after it sets and dries. See detail D, Fig. 2.

After an hour or two, during which time the mortar or concrete attains its initial shrinkage, you can use a steel trowel or a float to get a smooth or a rough finish respectively. Move the trowel or float sideways with slight downward pressure and with the advancing edge raised a little as



in detail A, Fig. 3. To hold concrete at the edge of a walk, use a flat board and stakes, detail B. When a patch crosses a joint, use a groover, detail C, to continue the groove. Use an edger, detail D, to round the outside edge next to the form. After a few hours, when the surface has set hard enough to resist marring, lay a piece of tar paper over the patch and cover this with sand or dirt as in Fig. 7. Or, cover the patch with a layer of grass clippings about a foot thick, and soak them with water. Such coverings retard evaporation and permit concrete to cure slowly, which is necessary to obtain its greatest strength. Keep the patch covered for a week.

Filling walk-to-wall cracks: Where walks join exterior masonry walls, keep the crack tightly sealed to prevent entrance of water and also the removal of soil from under the walk by ants. Ants can remove considerable soil as shown in Fig. 8. This, together with water, often causes the walk to settle and tilt as shown in detail A, Fig. 9. Cracks $\frac{1}{8}$ or $\frac{3}{16}$ in. wide can be sealed with asphalt roofing cement or calking compound forced in deeply with a calking gun, detail C. Such calking will adhere firmly to masonry surfaces if applied when the surfaces are dry. If not dry, you must first dry the sides of the crack with a blowtorch as in detail B. If properly applied to small cracks, roofing



Undercut the Sides



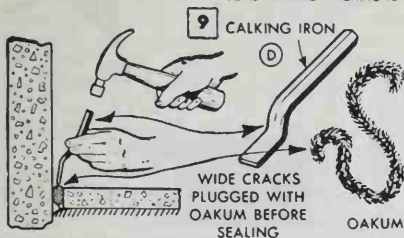
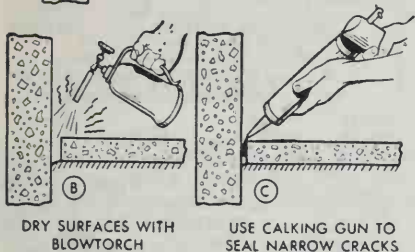
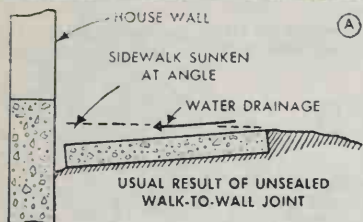
Soak Thoroughly With Water



Apply Grout Coat



Cover for Slow Curing



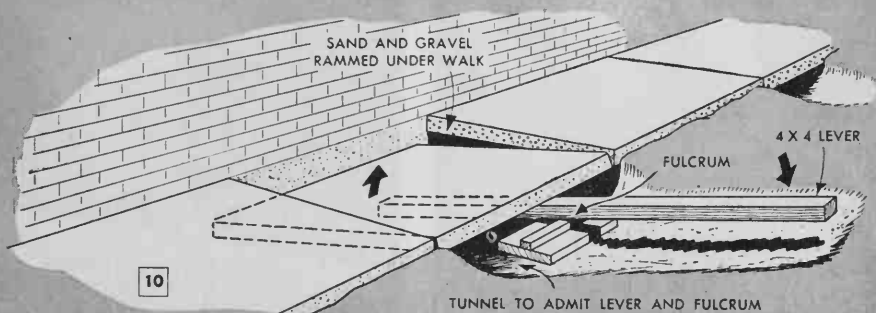
cement and calking compound remain slightly flexible and will not loosen from slight expansion and contraction of the walk.

For sealing wider cracks, first brush out loose particles and dirt, dry the surfaces, and then smear oakum or jute with roofing cement or calking compound before tamping in place. Use a calking iron and hammer as in detail D. Leave just enough space above the tamped fill for a layer of seal. If only roofing cement or calking compound is used for wide cracks, the seal may loosen from shrinkage.

Leveling tilted walks: Badly tilted walks that are still in good condition sometimes can be pried up level as in Fig. 10. While a helper holds up a walk section with a heavy wooden lever, gravel or crushed stone and sand are tamped firmly under it. After leveling the walk, seal the crack along the house wall as explained in the preceding paragraph.

New walk sections: When replacing one or more sections of a walk—or laying a new walk—break up the old concrete with a heavy sledge and remove it. You can use the pieces as in detail A, Fig. 12, to help save concrete. Soak the chunks to prevent rapid absorption of moisture from the new concrete. Leave enough space between the pieces for the concrete to anchor securely.

Whether or not pieces of old concrete are used as fill, the first step in laying a walk is to excavate to proper depth and erect forms, Fig. 11, to hold the concrete. Use 1-in. boards as wide as the thickness of the walk or driveway, 4 or 5 in. being recommended for walks and 6 in. for driveways. Hold the forms in place with pointed stakes driven firmly into the ground on the outside of the form and at 12 or 15-in. intervals as in detail B, Fig. 12. The stakes should not extend above the forms. Nail the forms to the stakes with 4d nails with heads driven down flush. One side of the form should be slightly lower than the other, about $\frac{1}{4}$ in. per ft. of width of the walk,

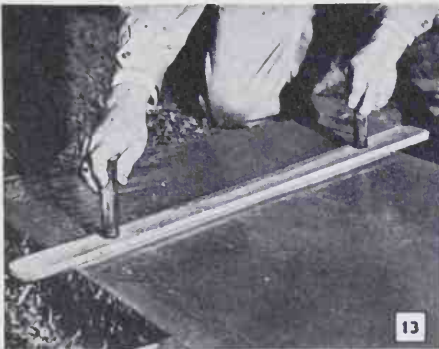
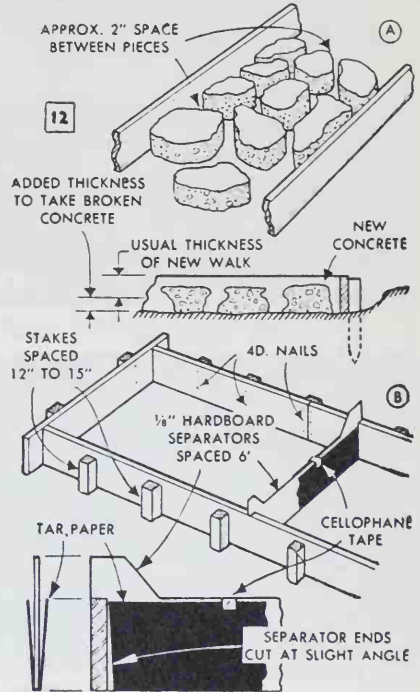
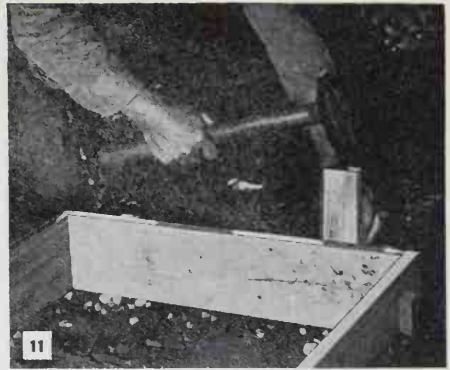


to provide a slight slope for drainage. Use a level across the forms to adjust for height. Wide walks and driveways are crowned sometimes instead of being sloped toward one side.

Concrete walks and driveways can be laid directly on well-drained and well-compacted soil. When laid on poorly drained soil that cannot be tilled, a 5-in. subbase of gravel or cinders is first laid and a drain is placed to carry off water that collects under the walk. If no drain is provided, the porous subbase merely serves as a reservoir for water to collect and thus defeats its own purpose.

When laying a new walk, use separators $\frac{1}{8}$ to $\frac{3}{16}$ in. thick and as wide as the thickness of the walk, to form joints for expansion and contraction. You may be able to rent steel separators from a concrete contractor. Otherwise, make them from $\frac{1}{8}$ -in. hardboard, detail B, Fig. 12. Place them at right angles across the forms and at intervals of about 6 ft. By inserting them in a folded piece of tar paper they are easily removed. Place the concrete on both sides of the separators at the same time to keep them straight. Then remove them when you finish the surface, leaving the tar paper in the joint.

Walks and driveways can be laid in one course. The mix for this is 1:2:3 of portland cement, sand, and crushed stone, or pebbles no larger than 1-in. dia., with water not exceeding $6\frac{1}{4}$ gal. per sack of cement. Immediately after pouring the concrete, level it with a strike-off board resting on the side forms, Fig. 14. Use a sawing motion as you advance. For crowning a wide walk or driveway, the underside of the strike-off board is cut slightly concave—and in this case the side forms are of equal height. While striking off, press interfering stones below the surface. In an hour or two finish the surface with a long float that extends over the side forms, Fig. 13. A strike-off board provided with handles will serve as a float. If a smooth finish is desired, use

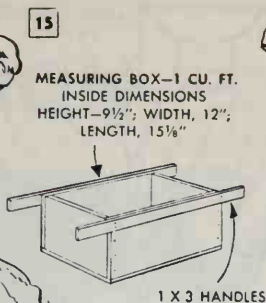




CUT CEMENT BAG AND
SPREAD CEMENT ON SAND



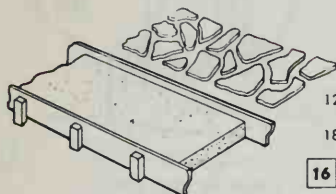
MIX BY SHOVELING OVER
INTO PILE AND REPEAT



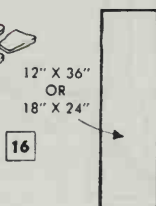
1 X 3 HANDLES



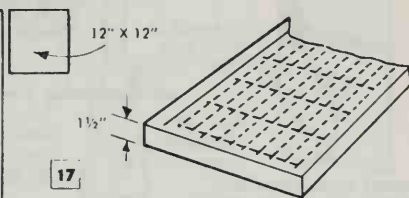
ADD MEASURED QUANTITY OF
WATER, THEN MIX



FLAGSTONES LAID OUT ON LAWN
BEFORE PLACING CONCRETE



16



17

REINFORCED-CONCRETE FLAGSTONES

a steel trowel in sweeping arcs. After removing separators, round the cross joints with a groover and the edges along the forms with an edger.

The two-course method of laying a walk is sometimes preferred as there is no interference from stones when surface finishing. The first layer is a 1:2¼:4 mix and is tamped down ¾ in. below the top edge of the forms. Then a mortar top course (1:2 mix of cement and sand with just enough water for workability) is laid on within 45 min. after laying the first course. Finishing is the same as already explained.

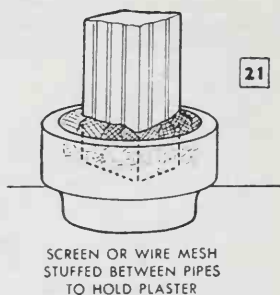
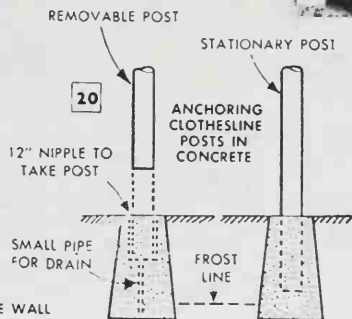
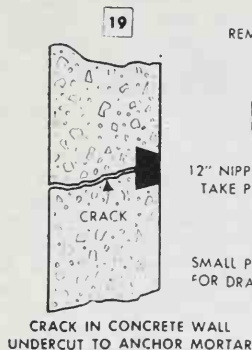
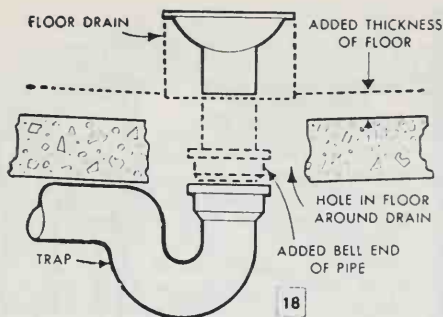
Ready-made concrete: The hard work of mixing large quantities of concrete by hand can be avoided in localities where you can purchase ready-made concrete. This is poured from the truck on which it is mixed directly into forms, or into wheelbarrows used to distribute it.

Mixing by hand: If you have to mix a large amount of concrete by hand, do it on a flat surface such as a driveway, Fig. 15. Be sure to remove all traces of each mix with a hose and old broom to prevent an accumulation of cement. Concrete aggregates are measured by volume. A sack of cement equals 1 cu. ft. To measure sand and gravel, use a box as detailed in Fig. 15. Spread a measured quantity of sand in a

layer on the mixing surface and distribute the required amount of cement over it. Then turn over the pile to mix thoroughly. Add the required quantity of crushed stone or gravel and repeat the mixing until you have a uniform distribution. At least three turnings are necessary to do this. Make a depression in the center of the pile to hold water, which should be clean enough for drinking, adding it as needed. Never use more than 6¼ gals. of water per sack of cement; less if the sand is very moist. Mix until all stones are covered with wet cement and sand. Use only clean sharp sand and clean gravel, properly graded.

Brick and flagstone walks: Where earth is well-drained and not subject to heaving frosts, brick and flagstone walks can be laid directly on it. Usually the excavation is made deep enough for a 2-in. layer of sand under the bricks or stones. By standing on flagstones already laid, instead of on the sand, the walk will remain level. Butt the bricks together or space them about ¼ in., filling the spaces later with sand. You can lay the bricks in any of several attractive patterns. Use a lawn roller to press them down to uniform height. If you desire, use mortar instead of sand to fill spaces between bricks.

Brick and flagstone walks will remain



level longer if they are laid on a 4-in. concrete base, Fig. 16. After tamping the concrete level, spread on a $\frac{1}{2}$ -in. layer of mortar just before placing the bricks or stones. If you are laying flagstones, arrange them on the ground as they are to be placed permanently, as shown, before laying the concrete and mortar, to avoid setting of the latter while experimenting with design and arrangement of stones. Fill joints with mortar. To prevent it from sticking to the exposed sides of the stones (or bricks) coat these sides with linseed oil. You can make concrete flagstones as in Fig. 17. Reinforce them with fence wire, preferably the kind that is welded together. Several such castings can be made in a large, partitioned form, which is greased to minimize sticking of the concrete. Use gravel up to $\frac{1}{2}$ in. in diameter.

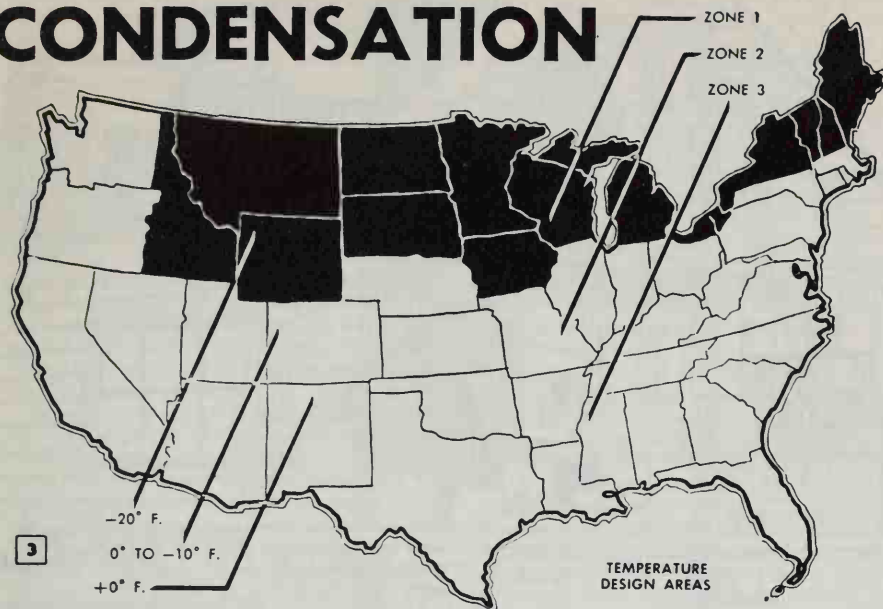
Resurfacing broken floors: Old, broken basement floors of concrete can be resurfaced with a 2 or 3-in. layer of concrete. Chip out embedded floor traps and install longer sections of soil pipe as in Fig. 18 to compensate for the added thickness of the concrete floor. If the soil pipe is cast iron, it is best to have a plumber add a new section as the joints are leaded. Joints of vitrified-clay pipe are sealed by tamping with oakum or jute, and filling with cement mor-

tar. Brush away all loose dirt from the old floor, soak it thoroughly and coat with grout. Do this in sections about 3 ft. wide so you can work the concrete to uniform thickness and finish the surface before laying the next section. Be sure to maintain the drainage slope.

Sealed wall cracks: To seal cracks in concrete walls with mortar, undercut both sides of the crack, Fig. 19, brush away all dirt and loose particles, soak the surfaces, apply grout and then the mortar. Do this at a time when water is not seeping through the wall. Large structural cracks should be examined by a contractor as they may indicate other and more extensive trouble.

Other concrete jobs: Steel clothesline posts are anchored securely in concrete as in Fig. 20. The concrete should extend below the frost line. For circular clotheslines, embed a short length of pipe in the concrete, in which to slip the post, permitting easy removal. Often it is desired to seal downspouts to iron or clay pipe leading to the house drainage system. Stuff some screen or fine wire mesh into the joint, Fig. 21. Then seal with plaster of paris rather than cement mortar; the plaster can be broken out without damaging the clay pipe. Waterproof the plaster with a coat of roofing cement, Fig. 22, to complete the job.

What To Do About CONDENSATION

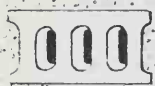
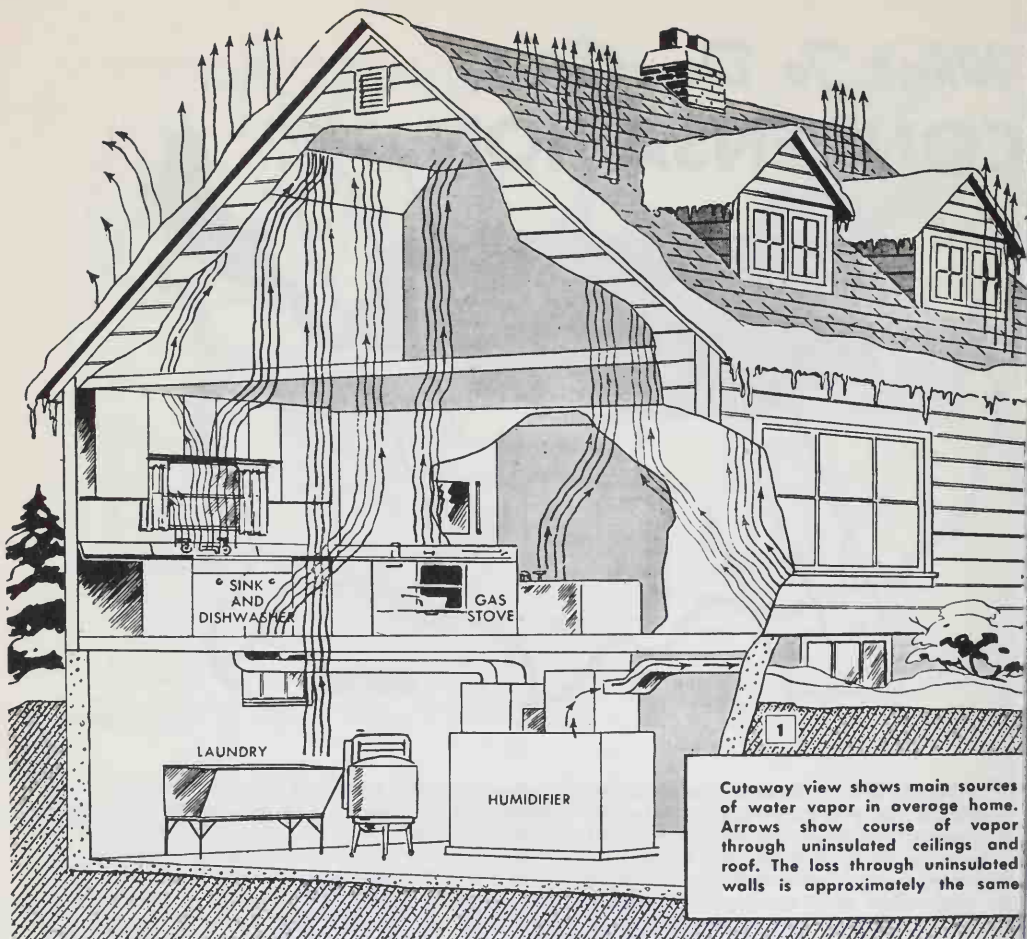


IF YOU LIVE in an insulated home, either new or old, you may have a moisture-condensation problem and not be aware of it. In some homes the damage caused by condensation may never become excessive and may affect only comparatively small areas in the house, but condensation becomes a real problem for the homeowner when it occurs on or within the walls and ceilings of the structure. The end results are certain to be water spots on the room side of the wall, peeling paint and, eventually, badly rotted framing members such as sills, studding, joists, plates and roof boards.

All air contains moisture in the form of water vapor, which ordinarily is invisible. When this vapor comes in contact with a cold surface, it condenses and forms tiny water drops or frost, depending on the temperature of the surface. The tendency of moisture-laden air to move to drier (lower pressure) areas generates what is known as vapor pressure. It is this pressure that forces moisture from a warm room through the walls of the house to the drier, colder air outside the walls. In uninsulated walls, the building materials are kept warm enough by continual heat loss to prevent condensation of moisture within the wall. That's why owners of older, un-

insulated frame houses seldom experience condensation trouble. In newer homes, built at the time when walls were insulated without vapor barriers, insulating materials prevented heat loss through the walls but did not eliminate the passage of moisture-laden air from inside the house. As a result, the space between inner and outer surfaces of the wall becomes very cold in severe winter weather. At some point within the wall the temperature of the air falls below the dew point and the moisture condenses. That's when the trouble begins.

While this brief outline of the basic cause of condensation is not all-inclusive, it does suggest some of the cures for this condition and certain steps that can be taken to control the generation of excessive amounts of water vapor at the source. The cutaway view of the typical 1½-story house in Fig. 1 shows some of the principal sources of water vapor in the average home. Note that the direction of the green arrows indicates an almost vertical travel of vapor from such common sources as the laundry, sink and dishwasher, gas stove and bath. Here, for purposes of illustration, it is assumed that the home is uninsulated and is covered with wooden shingles. In this case, although vapor pressure is more or less constant in all directions, the course of the



CONCRETE BLOCK

A



TERRA-COTTA TILE

B



BRICK GRILLE

C



SOLID MASONRY



FURRED, INSULATED



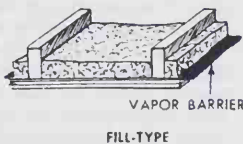
UNINSULATED, TIGHT FRAME

INSULATED, FRAME



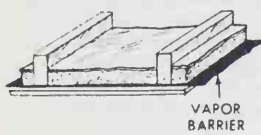
AIR SPACE

BLANKET



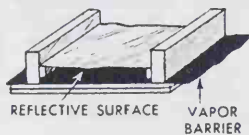
VAPOR BARRIER

FILL-TYPE



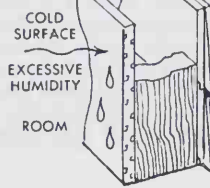
VAPOR BARRIER

BATT WITH PAPER WRAPPING



REFLECTIVE SURFACE

REFLECTIVE



COLD SURFACE

EXCESSIVE HUMIDITY

ROOM

VAPOR BARRIER

INSULATION

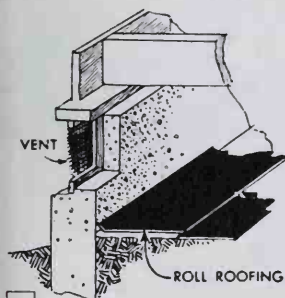
warm air will be generally upward through the ceilings and roof as well as through the walls. Snow will melt quickly from the roof area exclusive of the roof overhang at the cornices and over the dormers. This means that both heat and moisture-laden air are passing directly through the ceilings and roof. If the house has a composition shingle roof, heat will still pass through, but more of the green arrows would follow a horizontal course to the walls, as the composition roof is a fairly effective vapor barrier. Add insulation of the blow-in, or fill type, and the arrows would still follow much the same course through walls and ceilings. But add a vapor barrier, either a separate membrane or one attached to the insulation batts or blankets, and the arrows would turn back at the ceilings and walls. That's the answer to the condensation problem in modern homes.

Of course, there are other related factors. For example, in newer homes having no basement there is the problem of condensation on the joists and underside of the floor over a crawl space. Frequently, moisture generated in the crawl space will find its way upward through the walls and into the low attic, forming a damaging condensate in these areas of the building. One remedy is to provide adequate ventilation under the floor by means of openings formed by concrete blocks set sidewise in the foundation wall as at A in Fig. 2, or terra-cotta tile or bricks placed as in details B and C. Ordinarily, vents formed in this manner are placed near the corners of the foundation, rather than at the center. In this way adequate cross-circulation of air will be assured. In some cases, it will help to cover the ground inside the foundation walls with roll roofing laid with 4-in. lapped and cemented joints, as in Fig. 4. Then the underside of the floor should be insulated by either of the methods detailed in Fig. 4. A and B. In older, uninsulated homes

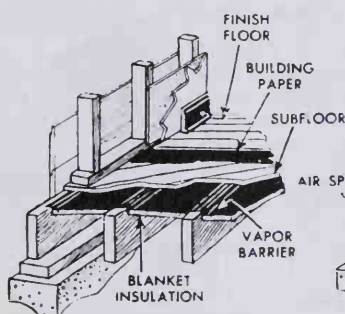
of masonry or of tight, frame construction, and especially those with inadequate heating systems, trouble often is experienced with condensate forming in upstairs rooms, generally on the walls on the coldest side of the house. Here the walls become very cold and the vapor in the air condenses on the surface as in details D and F in Fig. 2. Often this trouble can be overcome, at least temporarily, by providing additional heating facilities to raise the temperature of the air in the rooms and thus indirectly warming the walls. Where the walls are of solid masonry, the permanent remedy, of course, is to replaster the walls over furring strips, insulation and a vapor barrier as in Fig. 2, detail E. In walls of frame construction, install insulation and a vapor barrier as in Fig. 2, detail G.

In any case, to be fully effective, the vapor barrier must be continuous and unbroken over walls, ceilings, and also where used under floors. When applying the barrier in either old or new construction, don't fail to make an adequate seal around ceiling and wall-light fixtures. Don't forget the space around the attic door, Fig. 7, and be sure that the barrier is correctly placed at the junction of the attic floor, roof and side wall, Figs. 5 and 8. Be especially careful when installing membrane-type barriers at the junction of dwarf walls with the attic floor and roof rafters, Fig. 5. Other precautions to be taken when building or remodeling are detailed in Figs. 6 and 8. Frequently, in newer homes with low attics, damp spots will appear on the ceilings for no apparent reason. These spots, which usually show on the north side of the building and near the wall, often are attributed to condensation, when actually the cause is an ice dam on the roof over the cornice as in the right-hand detail, Fig. 6. Water from snow melting on the roof at a higher level seeps downward to a point over the inner edge of the cornice and just over the plate,

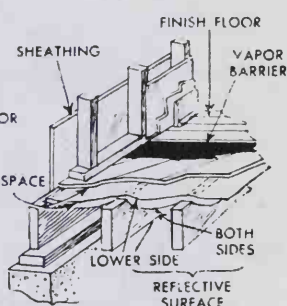
BASEMENTLESS HOUSE,
CRAWL SPACE WITH SOIL COVER



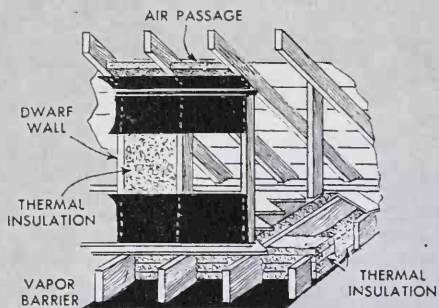
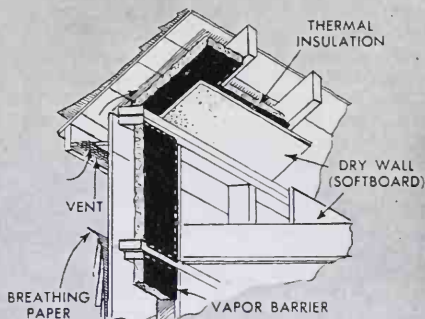
BASEMENTLESS HOUSE,
FLOOR DETAIL A



BASEMENTLESS HOUSE,
FLOOR DETAIL B

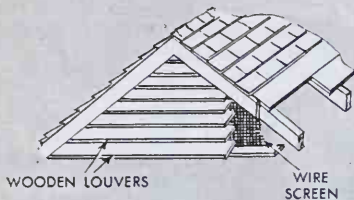


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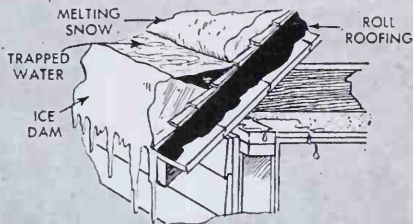
JUNCTION OF DWARF WALL,
FLOOR AND ROOFJUNCTION OF ATTIC FLOOR,
ROOF AND SIDE WALL

6

LOUVER-TYPE GABLE VENTILATOR

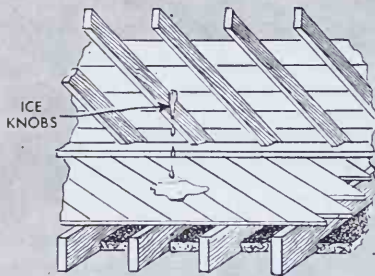


ICE DAMS AT EAVES CAUSE LEAKS

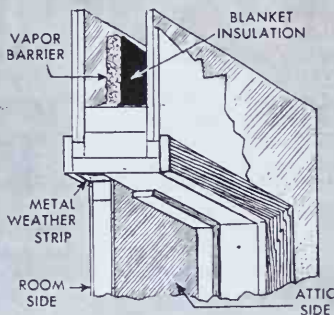
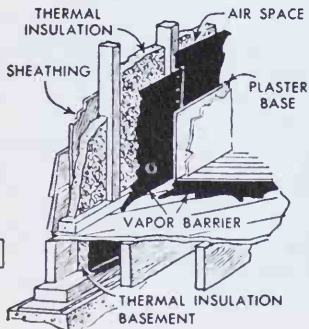
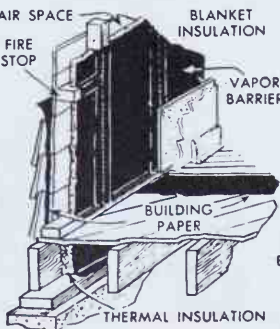
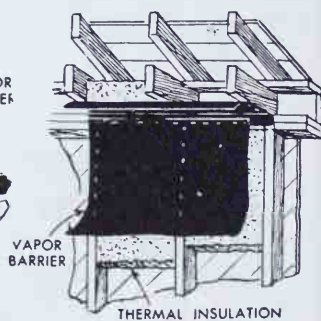


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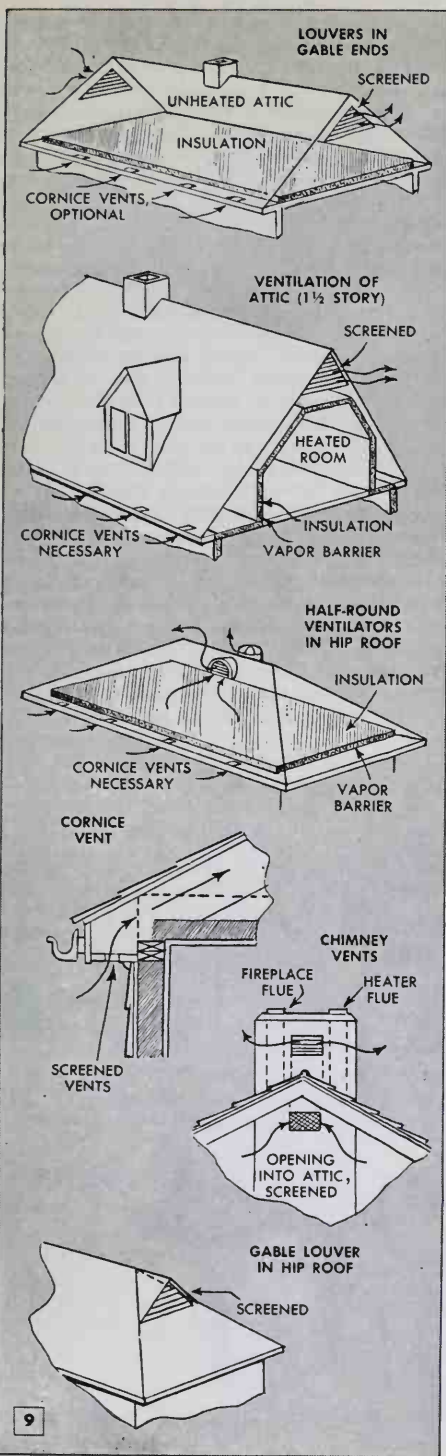
ICE KNOBS FORM ON PROTRUDING NAILS



WEATHER-STRIPPING DOOR TO UNHEATED ATTIC

SIDE-WALL CONSTRUCTION,
FIRST FLOORSIDE-WALL, FIRST-FLOOR
FIRE STOPJUNCTION OF ATTIC FLOOR,
ROOF AND SIDE WALL

8



where it freezes, forming a dam. During mild winter days water will be trapped above the dam in considerable quantity and may seep back underneath the shingles to the roof boards, through which it drops onto the plaster or insulation. The remedy is shown in the sketch. Simply place one or two widths of roll roofing under the shingles so that the upper edge of the roofing extends 18 to 24 in. above the plate. Another cause of trouble is presented by long nails driven through the roof boards or shingles so that they project into the attic. The nails are better conductors of heat than wood, and as a result, they become the coldest surfaces in the attic during severe winter weather. Frequently, due to the presence of excessive amounts of water vapor, large ice knobs form on the nails as in the left-hand detail in Fig. 7. When these knobs melt during mild weather they are a source of mysterious leaks into the rooms below. Probably the simplest remedy is to clip the nails off close to the boards, but inasmuch as the basic cause is the presence of excessive moisture in the attic, the permanent remedy is to control the generation of water vapor at the source.

Although ventilation is not a cure for condensation, it does provide the homeowner with a means of controlling excessive humidity, at least to a certain extent. Provision for proper ventilation of an attic is essential, and a cold-air duct with an outside air intake permits drier air to be introduced through the warm-air heating system. Tests have shown that approximately 40 percent of the moisture liberated in the preparation of meals over a period of one week is contributed by the cooking process. The remainder, roughly 60 percent, is liberated by the combustion of gas in a gas-burning range. Many homeowners have found that a kitchen ventilating fan, operated at regular intervals, effectively prevents an excessive concentration of water vapor from this source. Much can be accomplished simply by keeping cooking utensils and the washing machine, dishwasher and the clothes drier covered when in use. It also should be kept in mind that the furnace humidifier, the shower bath, unvented gas-burning space heaters and clothes drying in the basement contribute to the high humidity in modern homes of tight construction. These sources of water vapor can be controlled and, in some cases, eliminated entirely by simple measures carefully carried out. Usually, it is possible to vent a gas-burning space heater and a clothes drier. Shut off the furnace humidifier during mild weather when the cycle of operation lengthens. In some cases, it is possible to eliminate the

humidifier entirely when a gas-burning range is used in the preparation of food. The same would be true of evaporating pans on hot-water or steam radiators. In some homes, particularly in bathrooms, basements and upstairs bedrooms, window-mounted exhaust fans can be used to advantage in minimizing condensation. The capacity of the fan should not exceed 300 cu. ft. of air per minute. If a fan is operated regularly in a home of tight construction, it may be found necessary to install at least one outside air intake near the floor. This will permit fresh air to be drawn in and will prevent possible back drafts through chimneys and ducts.

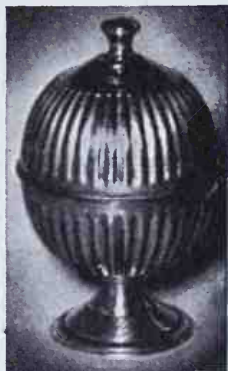
Ventilation of the attic by natural air movement is essential in most homes, even when ceilings and walls are properly insulated and provided with vapor barriers in any of the four ways detailed at the lower left in Fig. 2. Control of excess water vapor in both old and new homes by means of insulation, vapor barriers and ventilation is now conceded to be generally necessary in the three zones roughly outlined in the map of temperature design areas in Fig. 3. The temperatures given on the map are only approximations of the average winter low temperatures. Some recommendations specify these control measures in any areas where the average January temperature is 35 deg. F. or less. Adequate ventilation of

the attic is an important part of these control measures, and the details in Fig. 9 show several approved methods of attic ventilation by means of louvers and screened cornice vents. This is especially true of certain types of homes where the construction makes it practically impossible to prevent a certain amount of water vapor from reaching the attic space. Where proper insulation and installation of vapor barriers eliminate moisture from the attic, ventilation is still necessary to remove excessive heat which accumulates during a hot summer day. In flat-roofed and shed-roofed homes, the problem and remedy are essentially the same: Install cornice vents and leave an air space between the insulation and roof boards to permit free circulation of air. On flat-roofed homes a mechanical ventilator usually is necessary, as air currents alone cannot be relied upon to force hot air out through cornice vents.

The cost of installing membrane-type vapor barriers in homes already built usually is prohibitive. However, ordinary oil-base interior paints are a fairly reliable substitute, provided they are applied over a tight, smooth surface. Before applying the paint, fill cracks with a putty made by mixing paint of the color to be used with a small quantity of whiting. Allow this filler to dry thoroughly before painting.

Copper Float Provides Candy Dish

Something novel in the way of covered candy dishes can be had by assembling a flush-tank float, a lamp-base cap and a knob-type drawer pull. The seam around the center of the copper float is first broken with a file to separate the float into two parts. This leaves a small lip around the rim of each half. A $\frac{1}{4}$ -in. copper strip is soldered around the inside of the rim of the bottom half, which will serve as the bowl. The strip should project slightly above the rim to aid in locating the upper half of the float, or cover. The lamp-base cap is fastened to the threaded stud at the bottom of the bowl with a screw and washer. Then, a hole is drilled through the

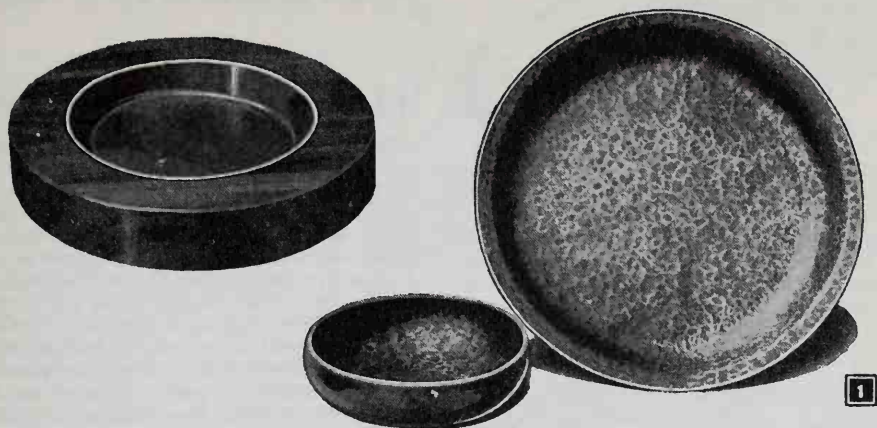


top of the cover to permit attaching the drawer pull. If all parts are of copper, simply polish the candy dish, but if different metals are used, it is best to have the unit plated.

Ⓐ Layer of heavy brown wrapping paper placed on the table under a new oilcloth will make the cloth wear longer.

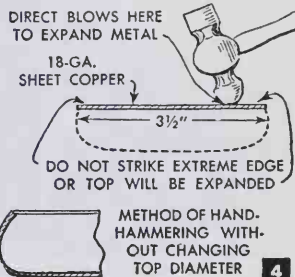
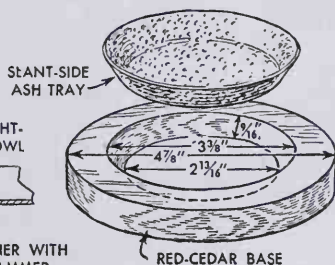
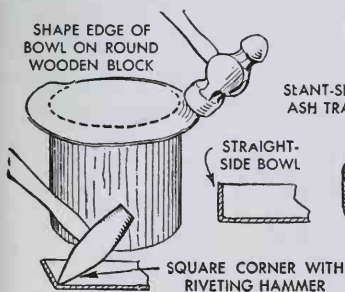
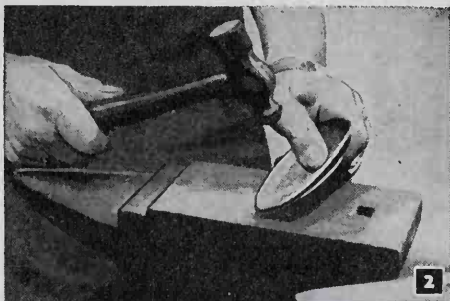


HAMMERED COPPER BOWLS

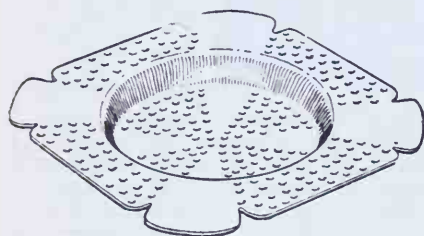
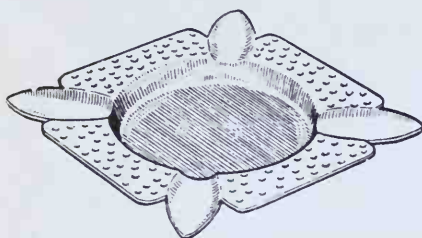
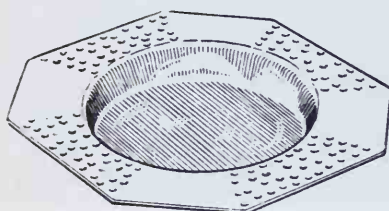
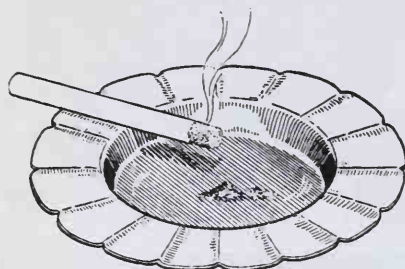
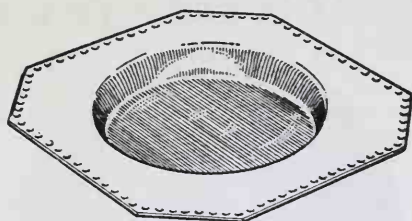


HAND-HAMMERED copper bowls,

Fig. 1, provide beautiful ash trays and serving dishes. They are especially attractive when set in a wooden base such as red cedar. To hammer a copper disk into a bowl having the same top diameter as the disk, right-hand detail, Fig. 4, use a ball-peen hammer and an anvil, as in Fig. 2. Direct each hammer blow toward the edge of the disk, but be careful not to hit the extreme edge as this will expand the metal and increase the diameter of the finished bowl. Hammer the entire surface once, and then anneal the disk by heating it to a cherry red and plunging it in cold water. Continue hammering and annealing in this manner until the desired shape has been attained. The top may be curved inward by holding the bowl in the hand and tapping around the rim with the planishing end of the hammer. Trays and flat-bottomed bowls are formed on a hardwood block, hammering around the edge and in toward the center as shown in the left-hand detail, Fig. 4. To flare the rim, hammer it against the edge of the anvil, as in Fig. 3. When the bowl is completed, lacquer it to prevent tarnishing.

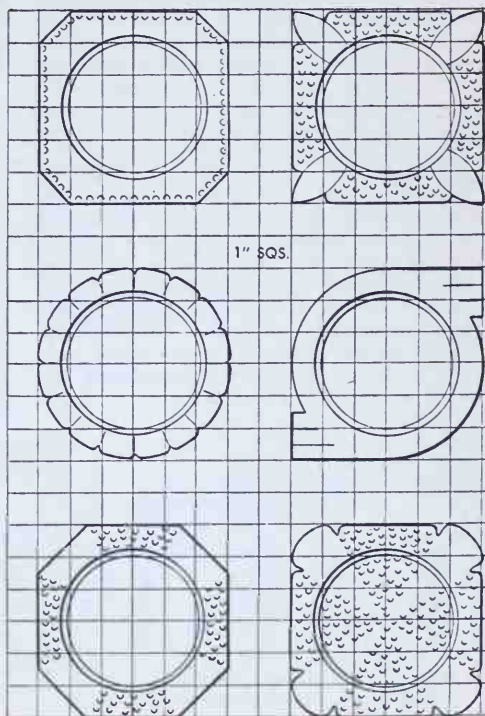


HAMMER 'em



HAND-WROUGHT in copper and highly polished, these gleaming ash trays are smart accessories for a basement rumptus room. The series of eight progressive steps pictured on the opposite page show how a tray is made. The mold is made by recessing a hardwood block $\frac{3}{4}$ in. deep, and the tools required are improvised from a tack hammer, a nail set, a small cold chisel and a wooden mallet. Each of the six designs given below requires a piece of copper 6 in. square which is annealed by heating it until it is purple in color and then quenching immediately in water. This softens the metal and reduces the chances of tearing it when hammering. The annealing operation is done once or twice during the forming. The rounded nose of the tack hammer is used to iron out any wrinkles in the metal at the corners of recess.

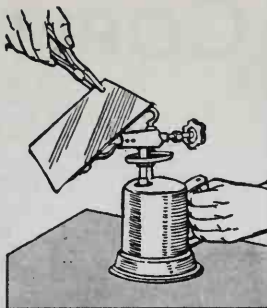
Dishing is done with the rounded end of the wooden mallet by centering the metal over the mold and working in toward the center from the outer edge of the depression in the block. As the dishing progresses,



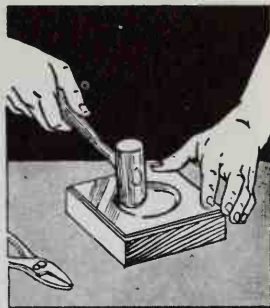
in COPPER

the metal will wrinkle at the rim. This is annealed and hammered flat with the smooth end of the mallet. When dished, the desired design is drawn on the rim of the tray with a pencil and cut with tinner's snips. The rough edges of the metal are smoothed with a fine file. The completed tray can be ornamented by engraving, peening or etching.

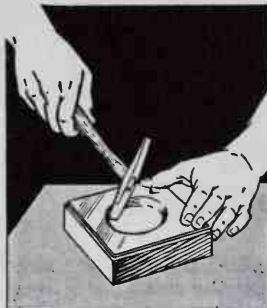
The trays can be finished in several ways. A satin finish is had by merely rubbing the metal with fine steel wool and a high polish can be obtained by buffing with jeweler's rouge. Another attractive finish is had by dipping the metal momentarily in a solution of nitric acid, one part, and water, four parts, and rinsing immediately in water. Care should be taken in handling the acid to avoid getting it on the hands or clothing. Whatever treatment is used, the finish should be protected from tarnishing by coating the metal with clear lacquer, applying it with a brush or spray gun.



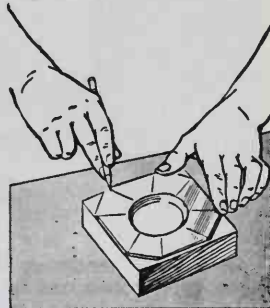
1st—Anneal copper by heating, then quenching in water



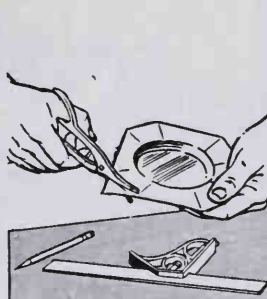
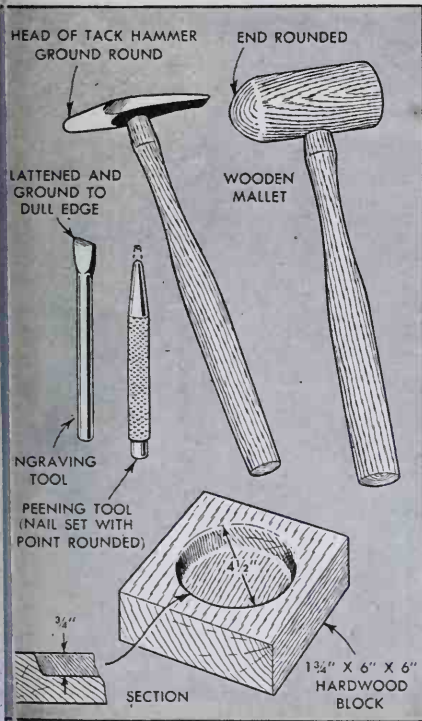
2nd—Dish metal by hammering into turned wooden mold



3rd—Use a tack hammer to iron out wrinkles in corners



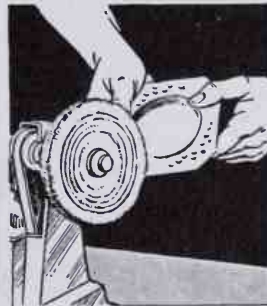
4th—Mark rim design with a pencil, following patterns



5th—Snip off corners. Then smooth rough edges with file



6th—Use rounded end of nail set for a peened effect

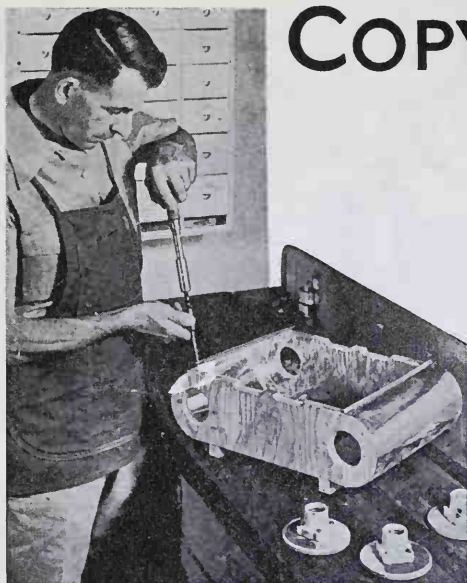


7th—Buff metal to obtain a bright finish by using rouge



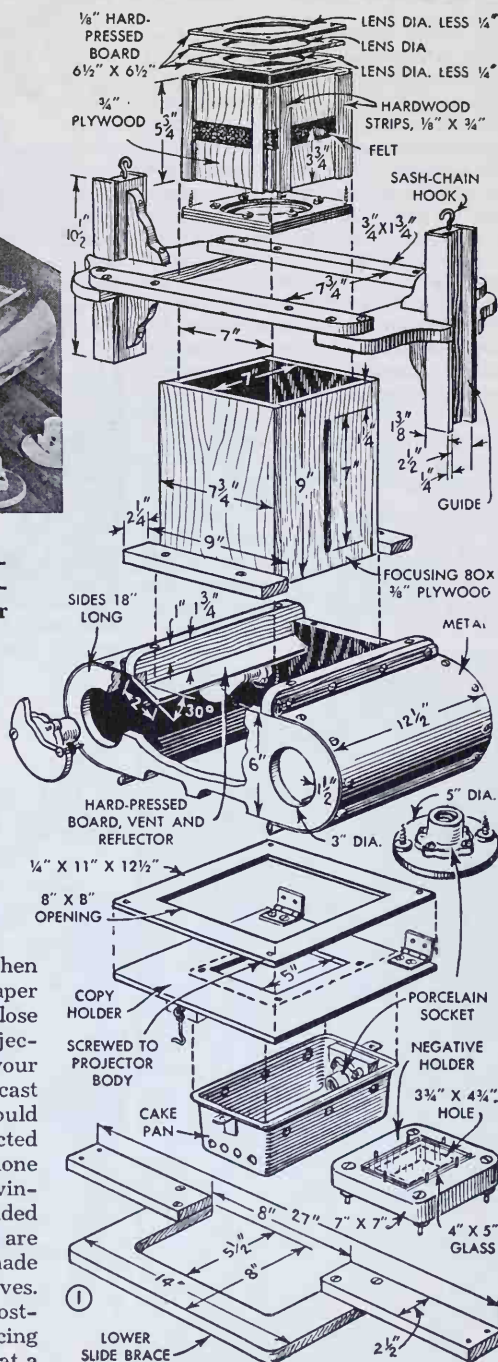
8th—Prevent tarnishing by applying coat of clear lacquer

COPYING TABLE



Eliminates usual hand shadow by projecting image from below. Spring counterbalances equalize weight of projector to give a positive focusing action

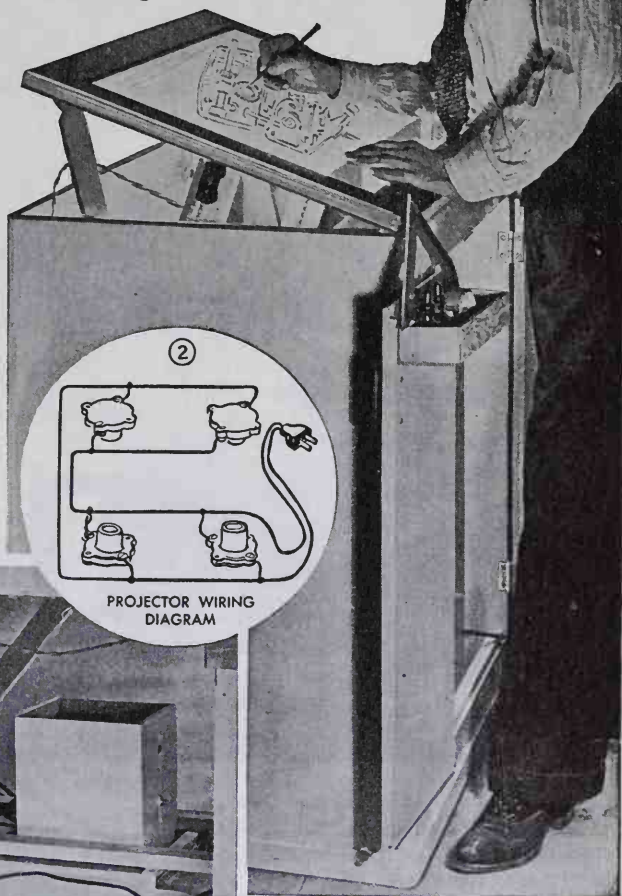
THIS multi-purpose "drawing camera" throws enlarged views of small patterns and pictures in magazines on tracing paper placed over a horizontal window, where it is an easy matter to trace them. You just place the picture in the copy holder as in Fig. 3, slide the projector up or down to get a sharp focus and then copy the picture or pattern on the paper held on the tracing window with cellulose tape. The advantage of having the projector mounted under the window is that your hand, when tracing the image, does not cast a shadow to obscure the work, which would be the case if the picture were projected from above. Direct copy work can be done by placing the picture on the tracing window and using the special lights provided for this purpose. Of course, best results are had in a darkened room. Provision is made also to copy enlarged views from negatives. Besides, the outfit can be used as a post-card projector by replacing the tracing window with a mirror, which is tilted at a



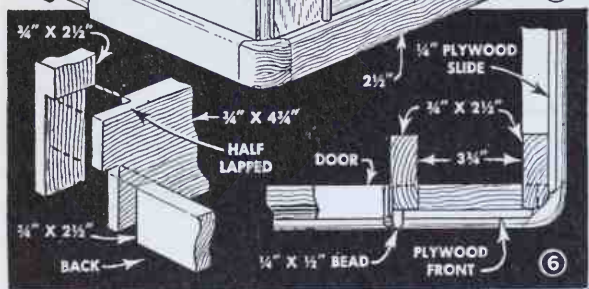
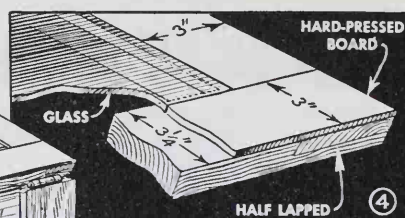
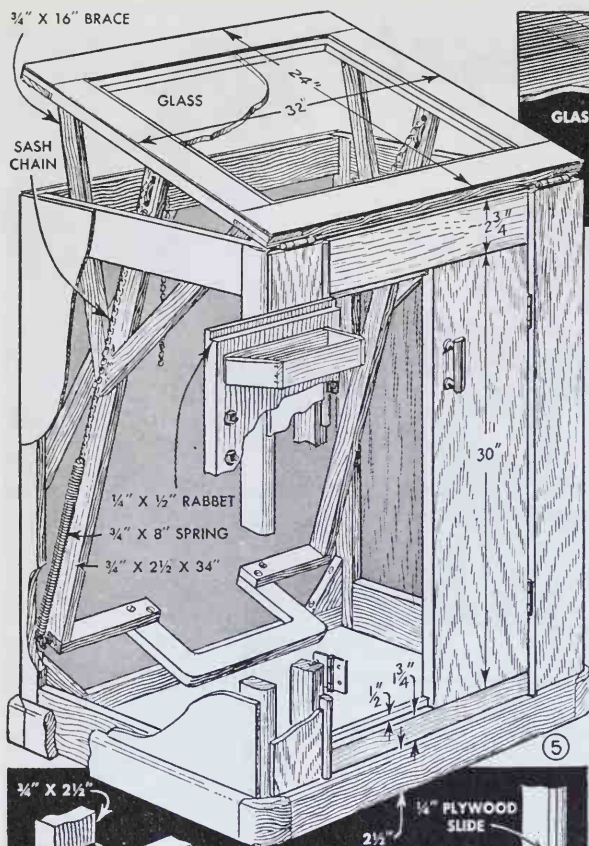
has built-in projector

45-degree angle to throw the picture on a wall or screen.

Construction centers around the projector itself, so start with this first. Fig. 1 shows the parts and their correct relation of assembly. If you cannot get plywood, use solid stock for the sides of the focusing box, lens holder and the lamp house. The latter, shown in the photo to the left of Fig. 1, has two beveled cleats across the top to which strips of hard-pressed board are fastened. These strips serve to deflect the light downward on the copy holder, and direct the heat out through the circular openings. Disks on which the porcelain sockets are mounted are spaced to stand out from the openings and provide vents. A few washers slipped over the screws will do the trick. Bright sheet metal salvaged from an oilcan



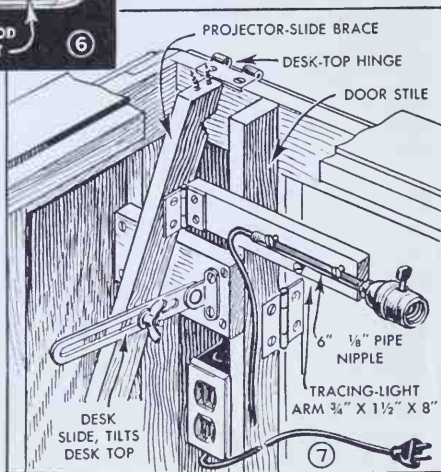
or similar container, will do to cover the rounded ends. You will notice that flanges are formed along the top and bottom edges of the metal, the top ones to permit attachment to the beveled cleats and the lower ones to overlap the edges of the copy holder. Wire the sockets according to Fig. 2, after first applying aluminum paint to



the inside of the lamp house. Next, you make the focusing box and the lens holder that slides inside of it. The latter is adjusted and locked by two wing nuts on bolts which project through slots in opposite sides of the box. After adding the hardwood strips at the corners of the lens holder, sand them down until a nice sliding fit is had and then wax both the strips and the inside corners of the box. Fill the space between the strips with felt as indicated, to stop light leakage.

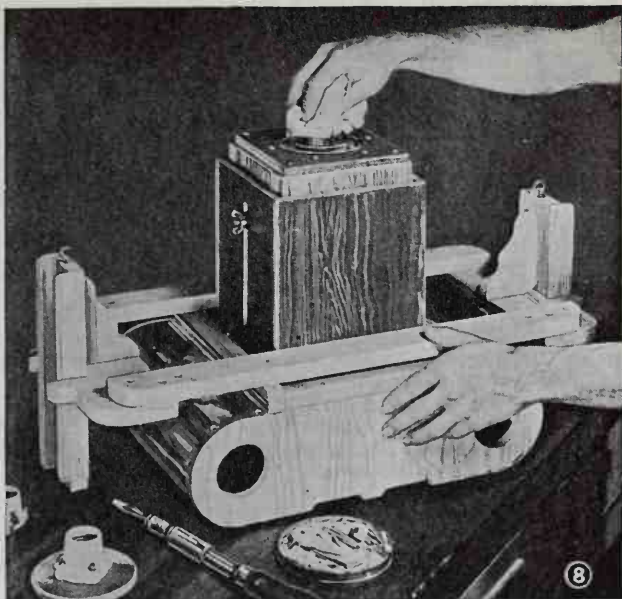
The efficiency of the projector depends on the quality of the lens used, especially if negatives are to be projected for tracing.

Although somewhat expensive, a corrected projector lens is the best. However, good definition can be had by using a camera lens. If you happen to have either a 4-by-5 Graflex or Speed Graphic camera lens with a focal length of about 5 in. and a speed of f:4.5 or better, it can be used in the projector by making a lens-board holder just like the one on the camera. Then you can use the lens from the camera on the projector, whenever needed. Sometimes a rapid rectilinear lens can be purchased reasonably from a pawn shop. A fourth choice would be the use of a pair of condensing lenses taken from an old lantern-slide projector. The upper detail in Fig. 1 shows how to mount a pair of these lenses. Each lens is sandwiched between two rings, the holes in



these being cut slightly smaller in diameter than a center one holding the lens. Usually these lenses have focal lengths of 6 and 8 in. Screw the 6-in. one to the bottom of the holder and the 8-in. one to the top, placing the convex faces outward.

Screws through the cleats on the focusing box are driven into the top edges of the lamp house and then the framework holding the channel-shaped guides is screwed to the top of the beveled cleats as shown in Fig. 8. Plywood is best for the two-piece copy holder. Screw the upper part of this to the bottom of the lamp house and hinge the lower part to it after you



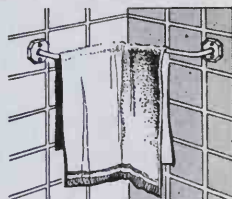
have attached the cake-pan reflector. Two or three screws are driven into the side of the lamp house to engage a hook on the lower part of the copy holder—one keeps the holder closed on a single sheet and the others provide space for magazines or catalogues. A holder for negatives is made to fit over the opening in the lower part of the copy holder as shown, four projecting bolts on the former engaging holes in the latter to keep it in place. Negatives are held between two pieces of glass which are centered over the opening with brads.

Now to make the cabinet: The cutaway view in Fig. 5 shows the vertical slides between which the projector travels. Being attached to the frame of the tracing window, they keep the projector at right angles to it, regardless of how much the top may be tilted. The brace joining the two slides at the bottom is U-shaped to permit further travel of the projector. Note in Fig. 5 how coil springs are used to counterbalance the projector. The springs are fastened to the outside lower ends of the slides and the chains, passing over standard sash pulleys fitted in the upper end of the slides, are hooked, under slight tension, to the channel-shaped guides of the projector. To work properly, the guides must fit the slides rather snugly. Desk slides, Fig. 7, lock the window at the desired slant. Fig. 7 also shows how two lights are in-

stalled, one at each side, on hinged arms to give illumination for direct tracing. On the original model 25-watt lamps were used here, a 150-watt lamp in the negative reflector and four of 100-watts in the lamp house. As shown in Figs. 5 and 6, the cabinet consists of a half-lapped framework fitted with doors at the front and covered with either $\frac{1}{4}$ -in. plywood or hard-pressed board. Strips of the latter are used around the top of the window frame to retain the glass as shown in Fig. 4.

Corner Rack for Bath Towels

Installing a towel rack in a corner of a bathroom not only creates a novel and pleasing effect but permits utilizing space which otherwise often is wasted. An ordinary towel rack can be used by just bending it at a right angle in the center and fastening it with screws to the two walls that form the corner as shown.



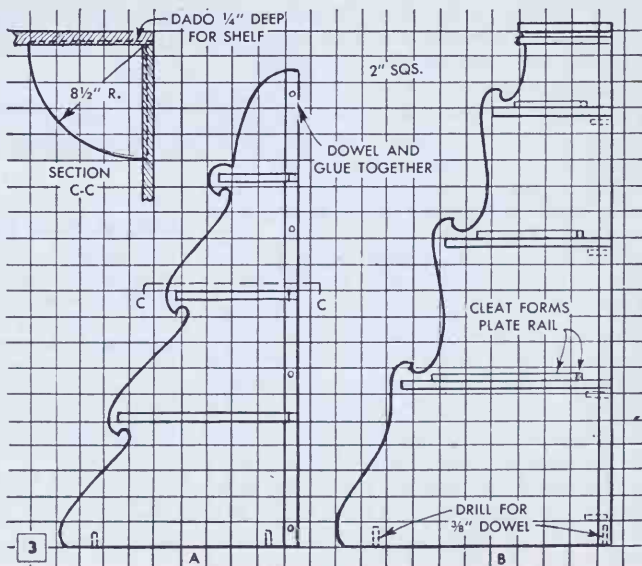
CORNER CUPBOARDS

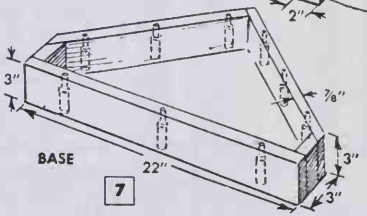
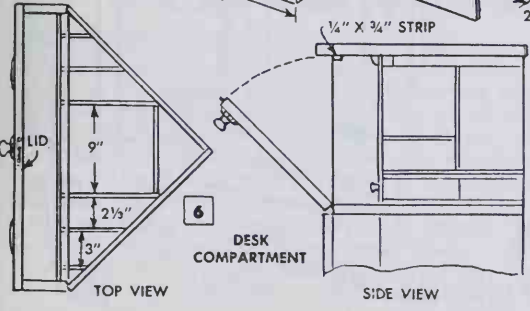
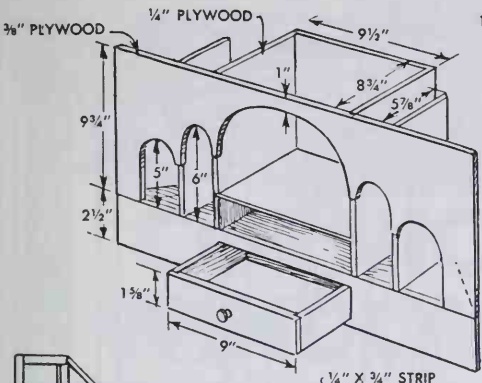
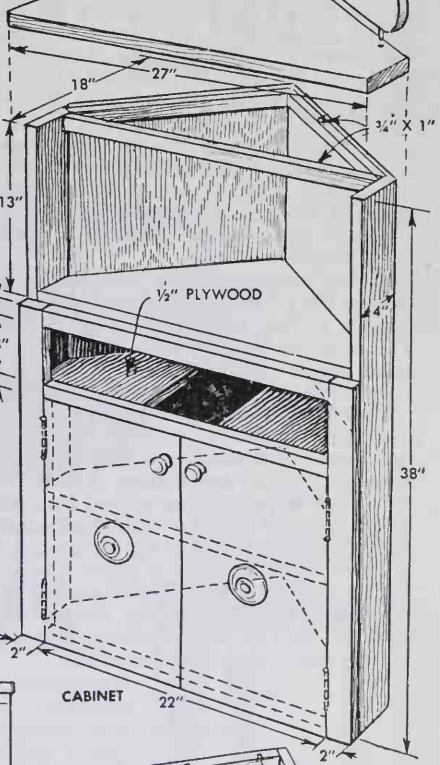
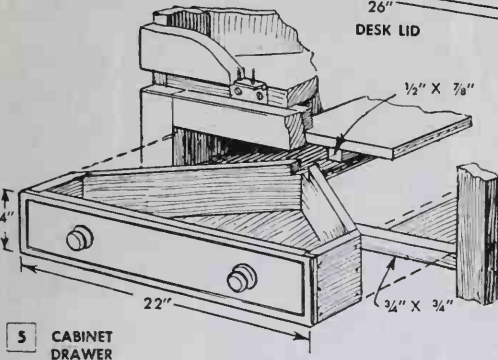
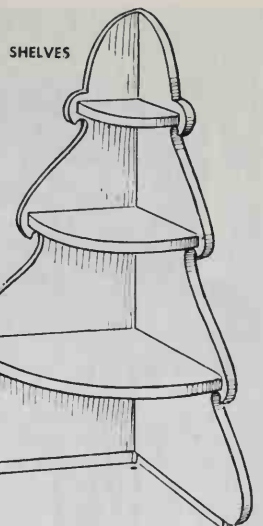
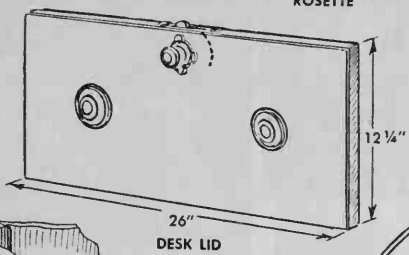
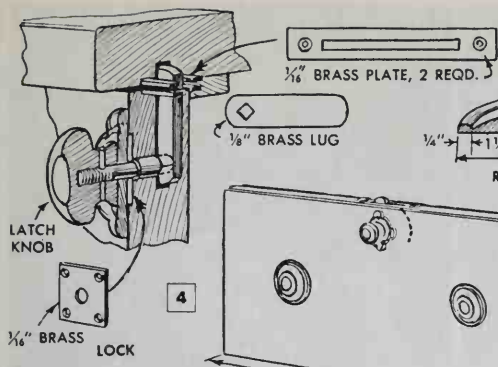
With Scrolled Shelves

SPACE-THRIFTY homemakers will find either of these corner cupboards an attractive addition to the room furnishings as well as a useful occasional piece for the den or recreation room. Both cupboards provide drawer and shelf space in the lower compartment, and open shelf space above. The combination cupboard and secretary has the convenience of compartments for personal papers and stationery, and a fold-down writing shelf, Fig. 8.

Both cupboards shown in Figs. 1 and 2 are built by first laying out full-size patterns for the framework on heavy wrapping paper so that dimensions can be taken directly from the layout as the work progresses. Mahogany was used for all exposed members of the originals, but maple or birch also is suitable. Rails for attaching the top to the frame are made up and screw-fastened, without glue, to allow for expansion. Dimensions of the base for each cabinet allow for a 2-in. recess across the front and ends, see Figs. 7, 10 and 11. In the back the base fits flush with the back panels.

The secretary compartment is made up as a separate unit, Fig. 6, and installed as one piece. The cut-out facing of the unit is made up of two pieces of $\frac{3}{8}$ -in. plywood, an opening being cut in the lower piece for a small drawer. A plywood base to support the upper part of the unit is glued flush to the inside



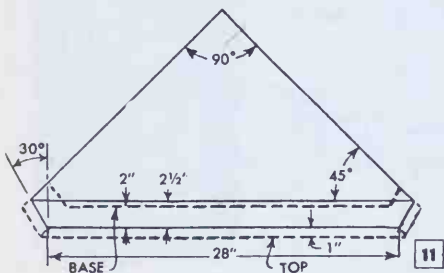
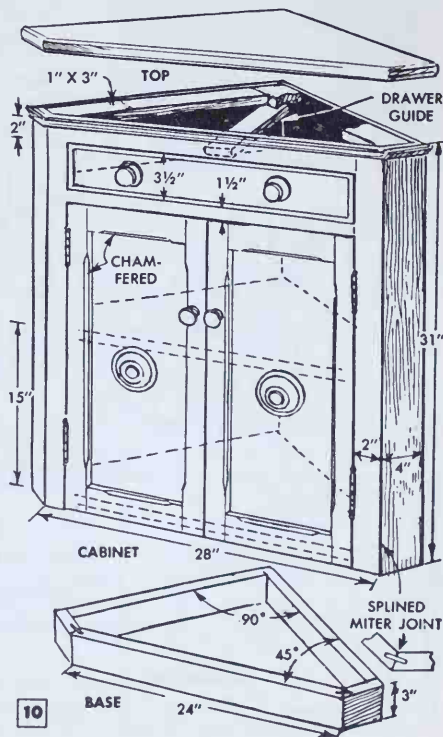




top edge of the lower facepiece and glue-blocked along the inside. Then pieces fitted at right angles to the drawer opening are installed to form a compartment for the drawer. Small cleats fitted along the inside of the compartment on each side support the drawer in a level position. After the top section of the unit is assembled and joined to the bottom one, the assembly is slipped in place in the cabinet and held at the top with a small molding. For the large drawer, shown in Fig. 5, an upper guide rail must be installed. This is made to the dimensions given in the drawings and a slot is cut in the back corner of the drawer to accommodate the guide rail.

A standard commercial lock can be used to hold the writing shelf closed, or a special locking device can be made as in Fig. 4. The homemade lock with its ornamental knob is more attractive. The detail shows how these parts are made and assembled.

The upper sections of the cupboards, with their scrolled shelf assemblies, are made by first drawing the outlines full size, Fig. 3, on heavy paper and tracing directly onto the wood, which is then sawed accurately to shape on the bandsaw. The shelf edges fit into blind dadoes cut in the sidepieces and are glued permanently in place. The completed assembly is mounted on the cupboard top, Fig. 9, by three dowels which hold the unit in place without gluing and permit easy removal for moving.



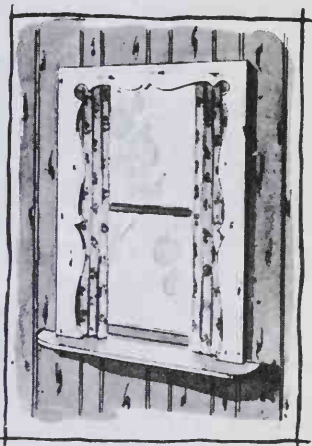


Ceiling-high cornice covered with fabric to match draperies brightens alcove, above. Sides and top of window, below, are decorated with scrolled cornice

CORNICE WINDOWS

CORNICES ARE BECOMING more and more important as a decorator's aid for creating a wide variety of pleasing effects in the home. They are used to accent windows, give the effect of a longer or shorter wall or a lower ceiling, to conceal drapery hardware, exhaust fans and lights and to change the center of interest in a room. If you are thinking about putting up cornices in your home, consider all the different types and their intended uses before making your selection.

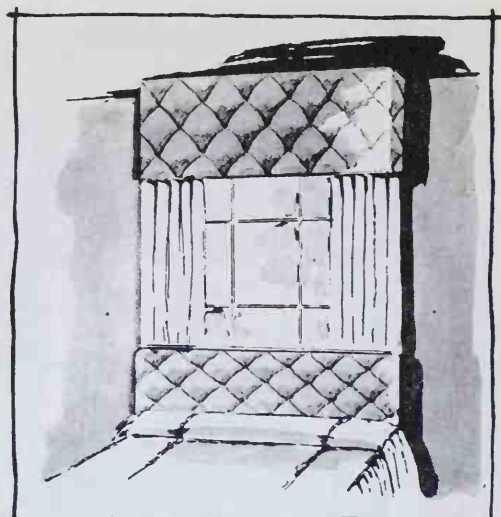
Smart cornices in vogue today often extend from window to ceiling, and many are covered with fabric to match or contrast with the draperies, furniture coverings or other room appointments. Other cornices are wallpapered, painted or covered with plastic fabric. The dominant period motif of the furniture often can be followed in the shape and design of the cornice. To relieve large unbroken window areas, cornices



sometimes are extended down both sides of the window, either to the sill or the floor. Instead of using separate cornices over the windows of a bay, you frequently can use one for the entire span, achieving a pleasing alcove effect.

But the use of cornices is not limited to the living-room and dining-room areas. They have applications throughout the house. In the kitchen, a cornice over the range can be used to conceal the exhaust fan and also may provide a mounting board for a kitchen clock. Cornices in a bedroom, in addition to being used over the windows, can dress up a bed alcove or a dressing-room entrance and add a feeling of real luxury to the room. Where a bed with an upholstered headboard is used, an interesting effect is obtained by upholstering the cornice to match the headboard. Often the appearance of a bathroom can be improved with a cornice that hides the shower-curtain rod, in which case the cornice is made of hardboard so that it will not warp due to steam from the shower. Awning-type cornices installed over real or dummy windows in the basement playroom are unusual and cheerful. They can be supported on a hardboard backing or hung on a heavy wire frame like exterior awnings. Gay red-and-white striped patterns are the most popular for this use.

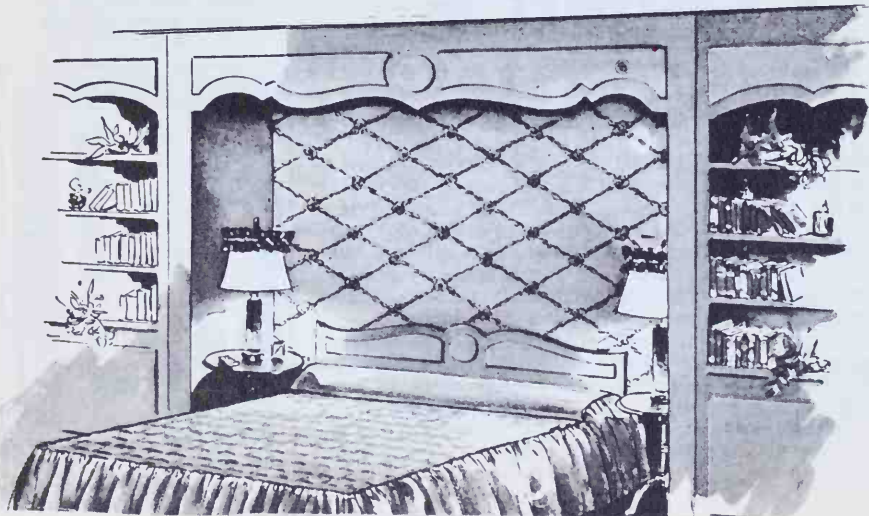
Other places around the house where cornices of various types can be employed with good effect are over bookshelves and across archways between rooms. Interesting illuminating effects can be produced by incorporating fluorescent lamps in cornices. Depending on the way in which the lamp is mounted, you can get direct downward

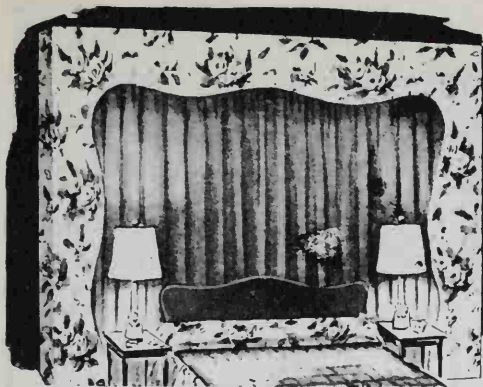


Bedroom-window cornice, above, is upholstered with same material as bed headboard. Cotton padding tufted with furniture nails produces the quilted effect



Long, narrow window cornices, above, serve a dual purpose when used to conceal fluorescent lamps for indirect lighting. Cornices over alcove and bookshelves, below, are scrolled to match bed headboard



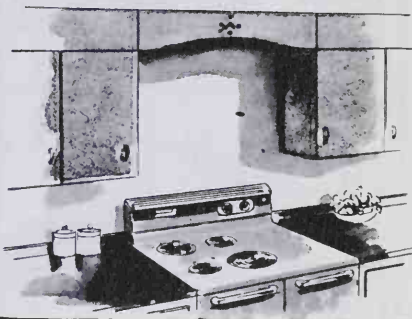
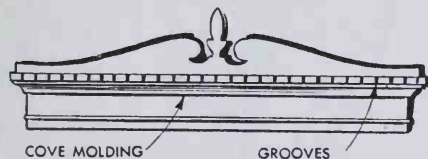
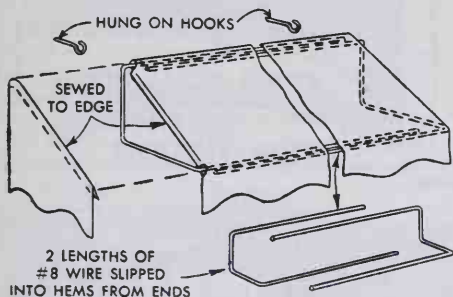
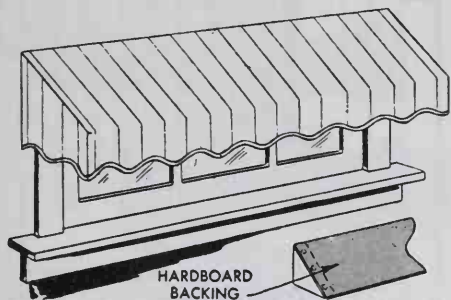


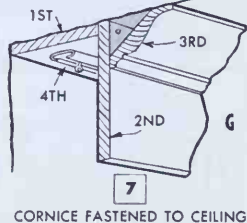
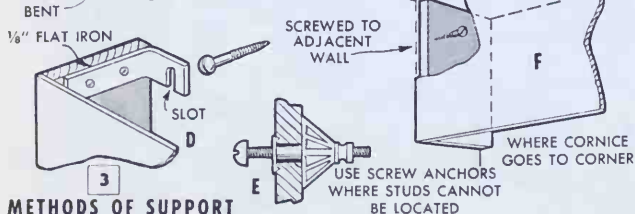
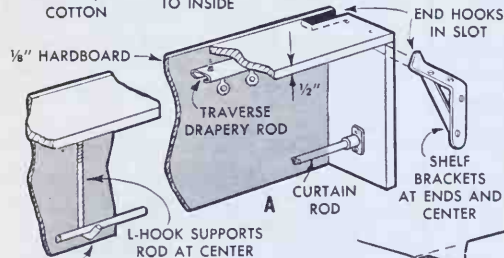
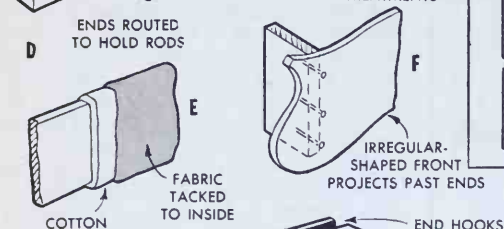
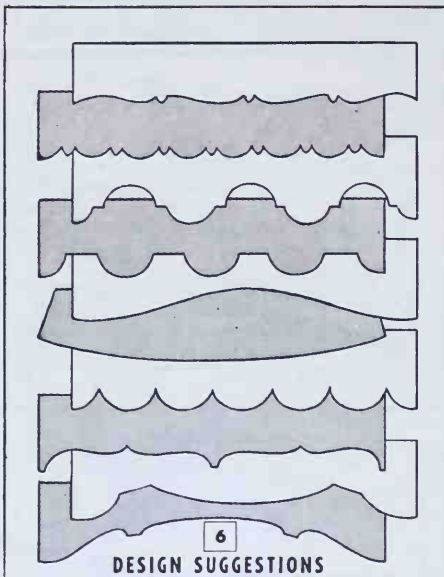
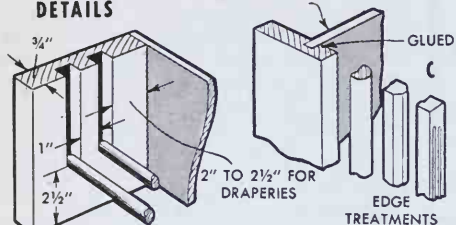
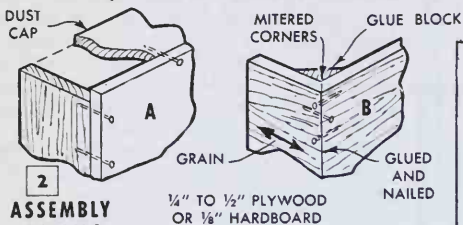
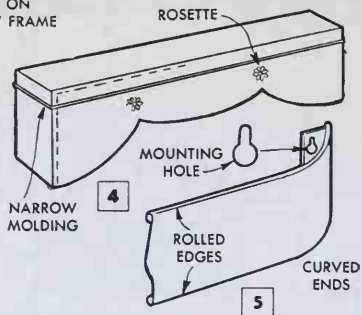
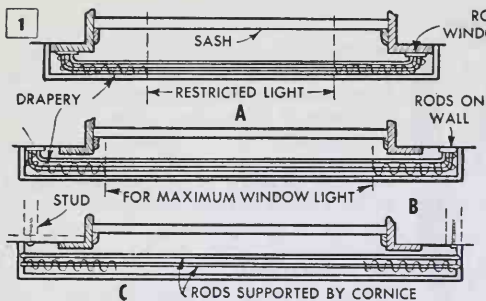
illumination or indirect ceiling light.

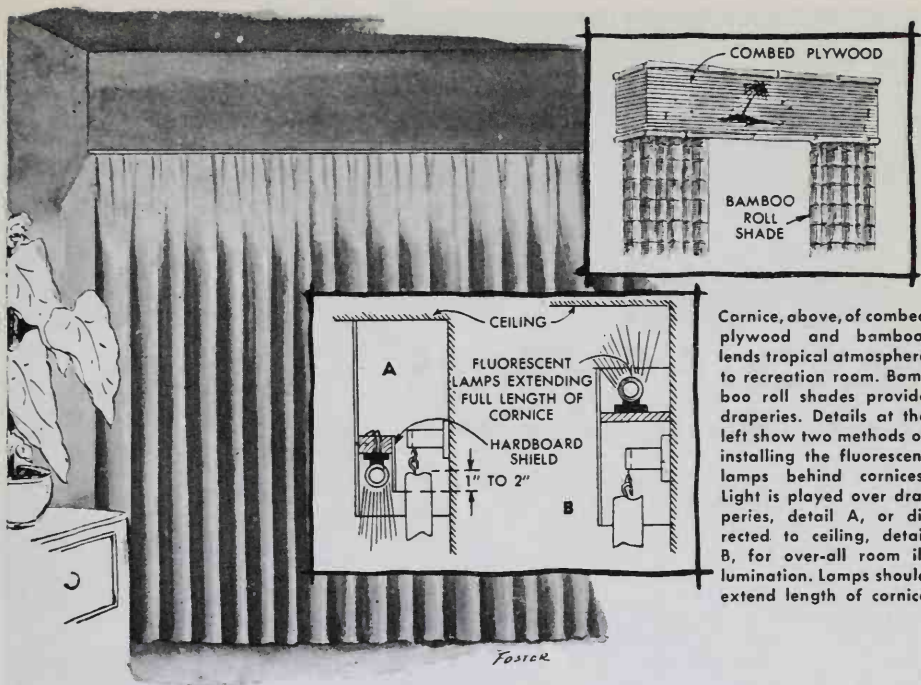
In designing cornices for your windows, here are some things to remember. Wooden cornices, if long and wide, often require scrolled breaks or curves to produce more pleasing effects (see Fig. 6). To soften the severity of lines or to "lighten" plain cornices, a cloth flounce is sometimes tacked to the lower edge. Narrow molding and rosettes, Fig. 5, often can be used to improve the appearance of a cornice. Instead of ending a cornice at each side of a window, you can get full light from the window by extending the cornice and draperies from 6 to 12 in. beyond the edges of the window if wall space permits. Cornices may be hung over curtain and drapery rods that are attached to the wall, or they can be built to include rods. Cornices that support considerable weight must be of adequate strength and must be securely attached to the wall, preferably to the studs. The location of the studs may be a factor in determining the length of the cornices. If they must be fastened to the wall between stud locations, use screw anchors that spread behind the plaster, Fig. 3. Shelf brackets with ends bent upward to fit into a slot in the cornice, detail A, will provide adequate support for a heavy cornice if they are fastened securely to the studs. Other methods of mounting cornices are shown in Figs. 3 and 7.

Lumber, plywood and hardboard lend themselves best to the making of cornices by the average homeowner. However, sheet metal also can be used, as in Fig. 5, in which case you should have a tinsmith roll the top and bottom edges to obtain greater rigidity and to eliminate sharpness.

When making cornices to be painted or otherwise covered, simply nail the front to the ends as in Fig. 2, A, the grain of the endpieces running vertically. Use crack filler on the end-grain and to plug nail holes, sand it down flush when dry. When cornices are long and narrow, and also when



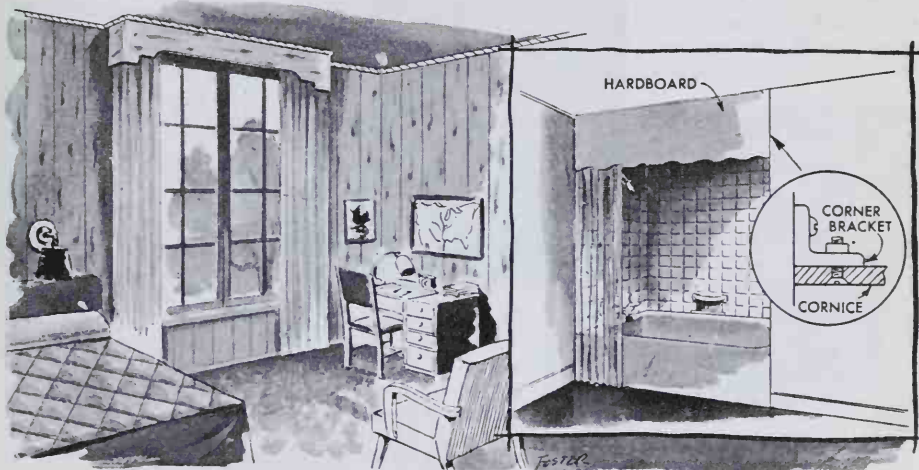




Cornice, above, of combed plywood and bamboo, lends tropical atmosphere to recreation room. Bamboo roll shades provide draperies. Details at the left show two methods of installing the fluorescent lamps behind cornices. Light is played over draperies, detail A, or directed to ceiling, detail B, for over-all room illumination. Lamps should extend length of cornice

light plywood or hardboard is used for the face, greater rigidity is obtained by adding a dust cap across the top. If cornices are to be stained or finished in a natural color or made of combed plywood, the grain direction of the endpieces should match that of the frontpiece, and the corners should be mitered, glued and nailed, detail B. Another method of assembly is to glue the front into grooves cut in the endpieces. However, the ends become more pro-

nounced in this type of construction. For holding two plain curtain rods in a relatively short cornice, the endpieces can be routed, Fig. 2, D, or slotted with a saw, the lower portion being closed with plugs. On curved or irregular-shaped cornices, the front may have to project past the ends as in detail F. When covering a cornice for an upholstered or quilted effect, use cotton upholstery padding before applying the covering material as in detail E. ★ ★ ★

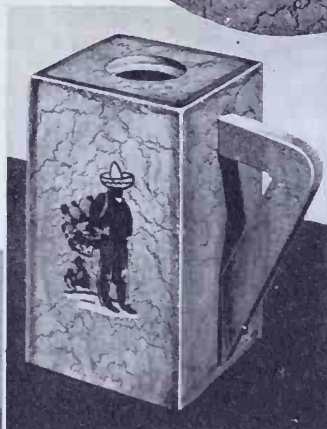
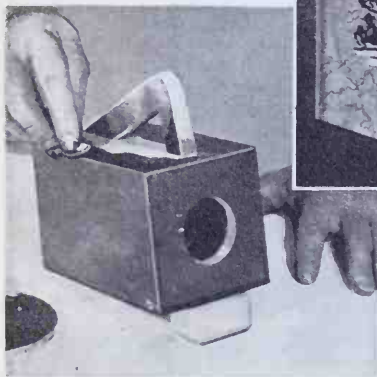
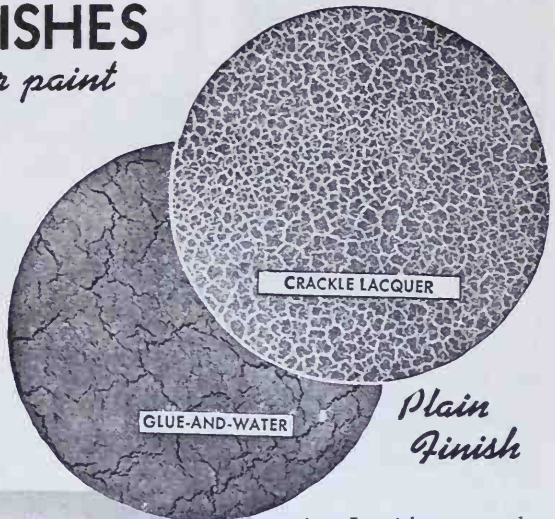




CRACKLE FINISHES

with glue-and-water paint

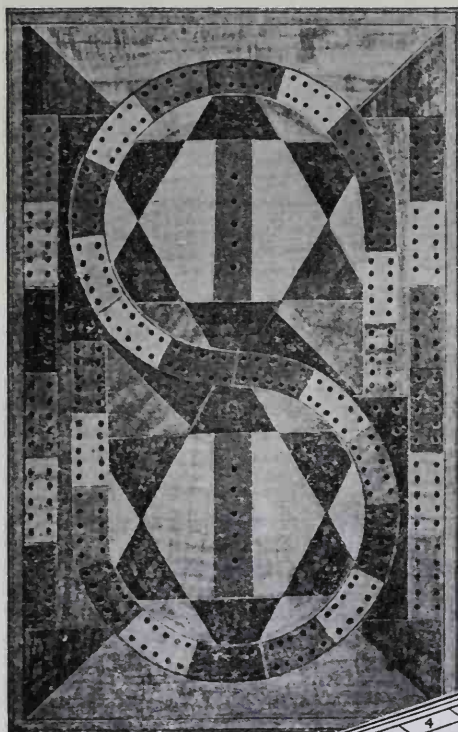
CRACKS or checks in a wood finish often appear by accident, but when you exaggerate this effect deliberately, you get an attractive crackle finish that is particularly suited to novelty furniture, household utensils and also to reproductions of antiques. Application is simple. Heat some fish glue in lukewarm water and coat the bare wood with it. Follow immediately with a spray coat of water-mix paint. The cracks will develop in about 10 min., as always happens when a fast-drying top coat is applied over a slow-drying undercoat. You will have best results with fish glue. Animal and other glues produce checks too fine to be readily seen. Heating allows the glue to flow better. If you brush on the paint, allow the glue to set 2 or 3 min. before applying the



Glaze Finish

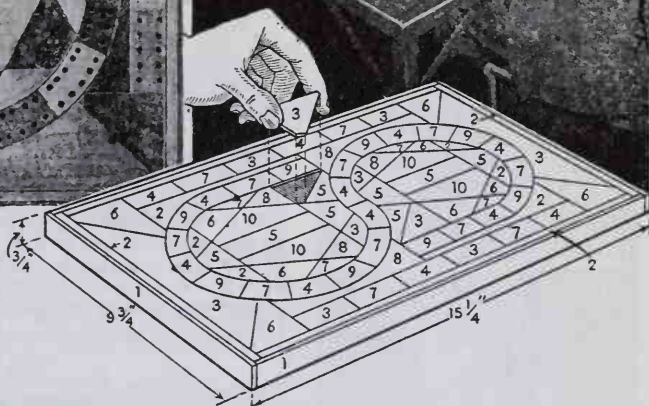
paint. In either case the paint should be of normal consistency—not too heavy. The finish will look best if a coat of white or light-color paint is applied over dark wood. If the wood is too light for contrast, it can be stained. Dark paint on light wood is not so effective, however. If you use open-grain wood, first fill it with walnut paste filler and allow this to dry thoroughly. For a true antique effect, the work should be glazed. The glaze coat is made by mixing any brown oil color in japan with turpentine to make a thin fluid. Brush this on over a sealer coat of clear lacquer, and then wipe off almost completely, leaving just a trace of color in spots, as shown in the lower photos. In all cases, the work should have a finish coat of clear lacquer or varnish.

CRIBBAGE BOARD



KEY

- 1—Olive
- 2—Sycamore
- 3—Birch
- 4—Bird's-eye maple, dyed blue
- 5—Purple heart
- 6—Walnut
- 7—Bird's-eye maple, natural
- 8—Philippine mahogany
- 9—Bird's-eye maple, dyed red
- 10—Burley maple

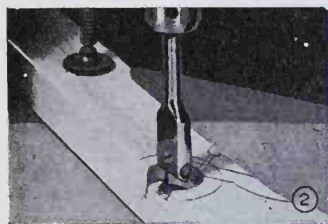


If you like to do wood-inlay work, try your hand at this decorative cribbage board. It's not only a beautiful piece for your own use, but it makes a gift that will be greatly appreciated. Ten different woods are arranged in a pleasing design to produce a colorful yet conservative effect. Positions of the woods in the pattern are indicated by figures in the lower right-hand detail; the key at the left shows the wood represented by each figure. If these woods are not available, it may be possible to make substitutions of a similar color without spoiling the pattern. Use warp-resistant wood for the base and sand it smooth, especially the top surface. Edges of the base are banded with olive wood and the pattern is bordered with strips of sycamore.



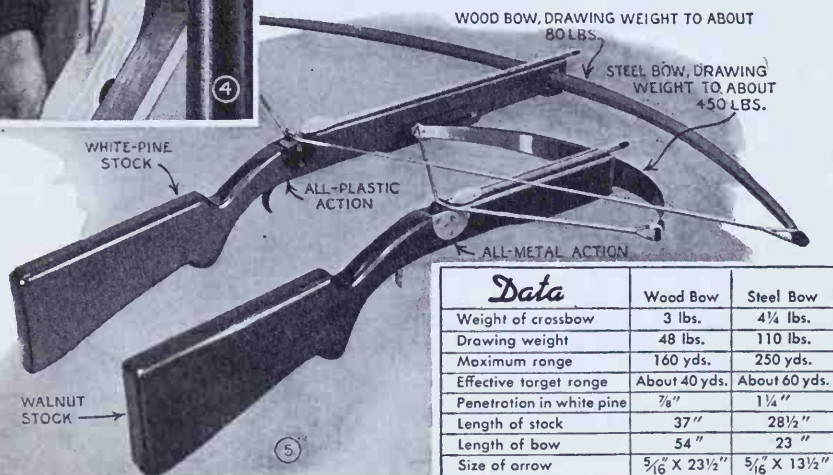


CROSSBOWS

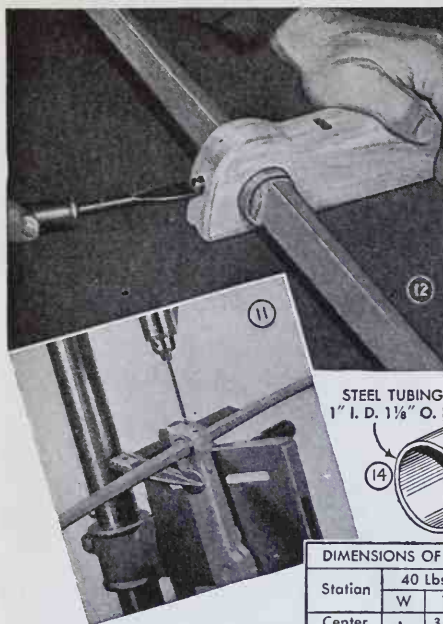


IF YOU can't hit the bull's-eye with a regular archer's bow and arrow, try one of these modern crossbows and you'll find yourself hitting the "gold" almost every time from distances up to 60 yds. They are good for hunting, too; a 160-lb. steel bow will stop anything short of an elephant. Two models are described in this story, both very similar in construction except that one has a wood bow and the other a steel bow. Comparative data is given in table of Fig. 5.

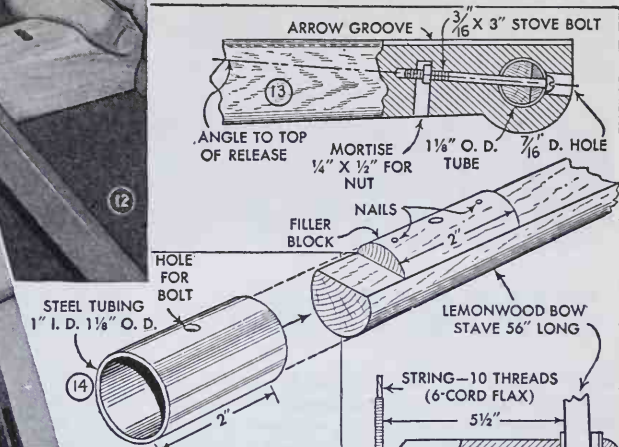
Stock for wood bow: The stock of the wood bow can be made from white pine. Its shape is very much like a modern rifle as can be seen in Fig. 8. Start the job by making a full-size drawing of the stock including the full detail at the trigger as shown in Fig. 9. Transfer the stock outline to 1 $\frac{1}{16}$ -in. white pine and saw it out. Drill the hole for the string release, using an expansive bit as in Fig. 2. Recesses on either side of the hole are run in with a straight shaper cutter, Fig. 3, the guide collar rubbing the hole. Lacking shaper equipment, the recesses can be cut with a router bit in a drill press. Fig. 4 shows the mortise for the



<i>Data</i>	Wood Bow	Steel Bow
Weight of crossbow	3 lbs.	4 $\frac{1}{4}$ lbs.
Drawing weight	48 lbs.	110 lbs.
Maximum range	160 yds.	250 yds.
Effective target range	About 40 yds.	About 60 yds.
Penetration in white pine	$\frac{3}{8}$ "	1 $\frac{1}{4}$ "
Length of stock	37"	28 $\frac{1}{2}$ "
Length of bow	54"	23"
Size of arrow	$\frac{5}{16}$ " X 23 $\frac{1}{2}$ "	$\frac{5}{16}$ " X 13 $\frac{1}{2}$ "



Wood bow is 54 inches long, made from lemonwood. Approximate section for 40, 60 and 80-lb. bows are given in table below. Bow is strengthened at center by steel sleeve



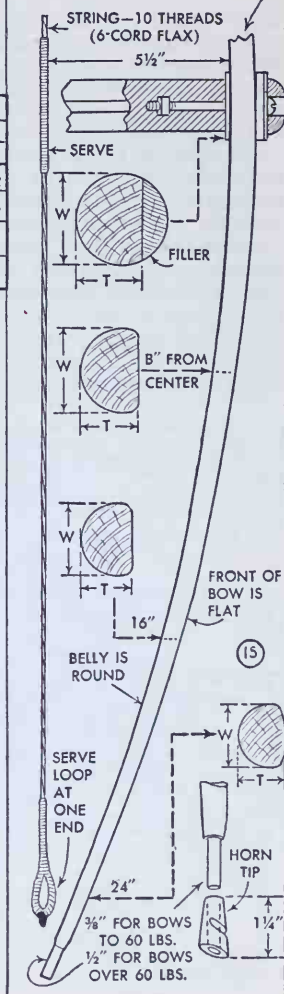
DIMENSIONS OF 54" LEMONWOOD BOWS

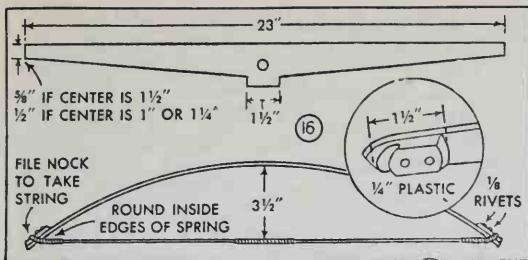
Station	40 Lbs.		60 Lbs.		80 Lbs.	
	W	T	W	T	W	T
Center	1	$\frac{3}{4}$	1	$\frac{13}{16}$	$1\frac{1}{8}$	$\frac{29}{32}$
8-Inch	$\frac{15}{16}$	$\frac{21}{32}$	$\frac{15}{16}$	$\frac{11}{16}$	1	$\frac{25}{32}$
16-Inch	$\frac{13}{16}$	$\frac{9}{16}$	$\frac{27}{32}$	$\frac{19}{32}$	$\frac{29}{32}$	$\frac{11}{16}$
24-Inch	$\frac{5}{8}$	$\frac{15}{32}$	$\frac{11}{16}$	$\frac{1}{2}$	$\frac{3}{4}$	$\frac{9}{16}$

Fig. 9. Fig. 10 shows the operation. The sharp edges are then faired into the shaper cuts. Be careful in fitting the release plates so that screws will not interfere with this sanding and rounding operation, in other words, keep the two top screws low. The plastic trigger has a small lug on the underside near the upper end to fit inside the trigger spring, as can be seen in Fig. 9.

The wood bow: The bow is made of lemonwood to the approximate sections given in the table. The 60-lb. pulling weight is recommended. The 80-lb. bow is very close to the maximum stress which can be imposed on lemonwood in this length of bow. Shaping of the bow follows standard practice, flat on the front, round on the belly. A section 2 in. long at the center is made full round by adding a filler block, as shown in Fig. 14, this section being enclosed in a steel tube. The completed bow is fitted through the hole at the front of the stock and is fastened with a $\frac{3}{16}$ -in. bolt as shown in Figs. 11, 12, 13 and 15. Note in Fig. 13, that the bow is tilted slightly so that the string when pulled back comes to about the top of the string release. If desired, the bow can be made by trimming down a regular 6-ft. bow of about 30 lbs. drawing weight. When this is shortened and the ends trimmed down a little, it will pull about 60 lbs. at 21-in. draw. Equally practical, a flat bow can be used instead of the stacked type shown, mounting the bow in a notch cut at the end of the stock. In any case, the bow must be worked carefully and broken in gradually, tugging a little on the string and then releasing until the full draw is obtained.

The steel bow: The steel bow, Fig. 1, does not have the silky, smooth shooting action of a good wood bow, and pound for pound the wood bow will outshoot it. Against this, the steel bow offers compactness and power, and, all

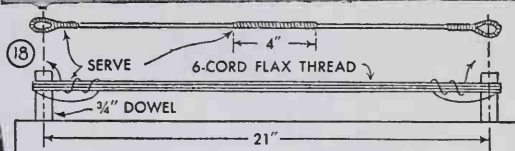
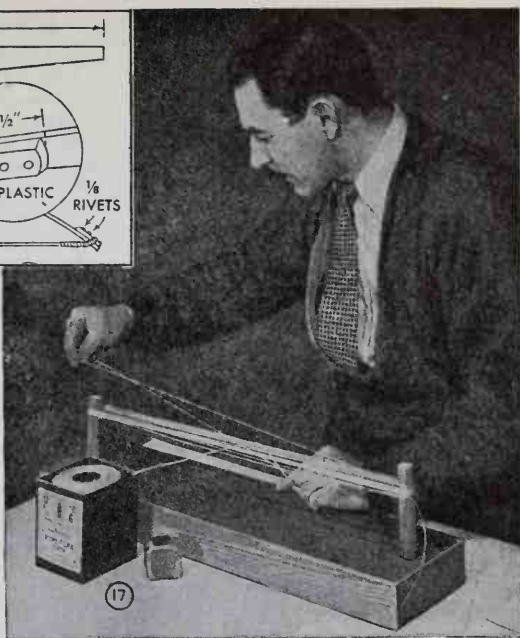




The steel bow is compact and powerful. Metal is obtained from a light automobile spring, which is sawed with high-speed steel hack-saw blade to the shape shown above



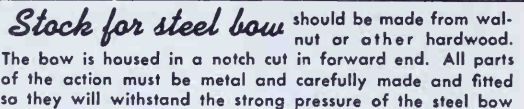
things considered, makes much the better cross-bow. The spring stock can be obtained from a light automobile leaf spring. It will cost you two high-speed steel hacksaw blades to saw it to shape, Fig. 19. If the spring is a little wider than needed, it is a good idea to leave the extra metal intact at the center, as shown in Fig. 16. The bow tips are cut from sheet plastic, riveted in place and filed to take the string. The steel bow will have an initial fixed set of about 2-in. deflection, and should be braced at 3 1/2-in. deflection as shown in Fig. 16. The table, Fig 20, shows approximately what leaf-spring steel will pull in pounds at 11 1/2-in. draw. A 100 to 160-lb. bow is recommended. Extremely heavy bows over 300 lbs. drawing weight make nice exhibition pieces for flight or penetration shooting, but are no fun to shoot as you seldom retrieve the arrow intact if at all. It is prac-



23-IN. SPRING-STEEL BOWS						
Spring Thickness	Initial Set	Brace	Spring to Release	Pull and Threads to Hold		
				1" Wide	1 1/4" Wide	1 1/2" Wide
1/8"	About 2 1/4"	3 1/2"	11 1/2"	42 lbs./12	52 lbs./12	63 lbs./12
9/64"	About 2 1/4"	3 1/2"	11 1/2"	60 lbs./12	75 lbs./16	90 lbs./18
5/32"	About 2 1/4"	3 1/2"	11 1/2"	83 lbs./16	104 lbs./20	126 lbs./24
3/16"	About 2 1/4"	3 1/2"	11 1/2"	142 lbs./28	179 lbs./36	216 lbs./42
7/32"	About 2"	3"	10 1/2"	188 lbs./38	236 lbs./48	285 lbs./56
1/4"	About 2"	3"	10 1/2"	289 lbs./56	363 lbs./70	438 lbs./82

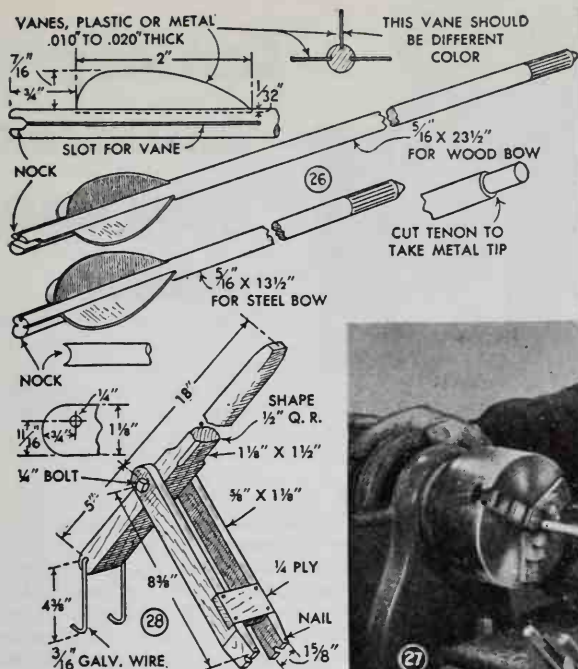
tical, however, to make two or three bows of different weights, all interchangeable on the same stock.

Bow strings: Bow strings for wood bows can be purchased or made from 6-cord flax thread. This kind of thread is used in stitching machines by shoemakers. Twelve threads will hold wood bows to 80 lbs., the loop at the end being made by turning the whole string back on itself. The string for a 23-in. steel bow is made on a simple wooden form, as shown in Figs. 17 and 18. In this case, the string is divided into equal parts to make the loops. Both loops and a distance of 4 in. at center are wrapped, and the completed string is waxed with beeswax. The string can be shortened by giving it several twists before fitting to the bow. The triangular-boxed figures in table



Stock for steel bow: Because of the heavier drawing weight, the stock for a steel bow must be made from walnut or other hard, strong wood. The stock should be laid out full-size, Figs. 21 and 24, then transferred to wood, cut out, and then machined in much the same manner as the wood-bow stock already described. An addition is the metal track on each side of forearm, Fig. 22. This originally was to protect the wood from the rubbing action of a metal bow string. The metal string (6-strand, 19-wire flexible cable $\frac{5}{32}$ -in. dia.) did not stand up under actual shooting and was discarded for the flax thread. The track, however, is worthwhile protec-

Arrows: Arrows for both bows are 5/16-in. birch dowel. Vanes are plastic, celluloid or metal, glued in grooves cut in the shaft.



Arrows are made from 5/16-inch birch dowel. The vanes are cut from celluloid and are fitted in the grooves cut in the shaft



used. Photo Fig. 7 shows the manner of using the lever. If the release is set slightly forward, the trigger will cock automatically when the string engages the rear prong of the release

Shooting: After cocking the bow, the cross bow is shot very much like a shotgun, sighting down the arrow to the target. A little practice will enable you to judge the range and drop of an arrow very nicely. When hunting, the bow can be carried cocked but without arrow. When not in use, the steel bow is left braced, but the wood bow is unstrung. Needless to say, any bow over 100 lbs. packs a terrific drive, and the utmost caution should be exercised in its use. Never fit an arrow in place until you are ready to shoot, and don't point the gun in any other direction than toward the target when the arrow is in place.



Cutlery handles you can make



Pattern for plastic-inlay design is traced on soap-rubber eraser and cut out, as above. Sides of cutout pattern must be perpendicular. Below, pattern is placed in bottom of aluminum-foil trough and rubber-mold material is poured over it

DRESSING UP your sporting knives and fine kitchen cutlery with custom-designed plastic handles is easy, and the results are sure to bring the admiration of your friends. These serviceable handles can be made as fancy as you like, as the molded plastic permits an endless selection of colors and patterns.

To make the handles, you'll need liquid casting plastic and catalyst, dye of the desired color, one or more soap-rubber erasers and some rubber-mold compound. The other items, like aluminum foil, razor blade and masking tape, you'll probably have around the house.

The first step is to cover the blade and metal tip of the handle, if any, with masking tape. Then remove the old handle from the blade, cutting or sawing as necessary but being especially careful not to mar metal surfaces that will be exposed when the work is finished.

Making the patterns for the inlays comes next. Be sure to keep the inlay small enough so that it will be at least $\frac{1}{8}$ in. from the sides of the finished handle when installed. Then trace or draw the design of the inlay on a soap-rubber eraser, using a pencil first and then going over the pattern with drawing ink. Then cut out the pattern, Fig. 1, with a single-edge razor blade or a coping-saw blade,



being careful to keep the sides of the pattern perpendicular to the face. Cementing strips of fine sandpaper to the sides of toothpicks will give you a supply of tiny cutting tools for the hard-to-reach corners of the eraser pattern.

Then make a trough from aluminum foil. This should be large enough to allow $\frac{1}{4}$ to $\frac{1}{2}$ in. of rubber-mold material to be poured over the top of the pattern and $\frac{1}{2}$ in. of the material on all sides. Place the pattern in the bottom of the trough, heat the rubber-mold material and pour it over the pattern, Fig. 2. After allowing the mold to cool, remove the foil and take the eraser pattern out of the mold. Fig. 3 shows several rubber molds ready for use.

Now mix the liquid plastic. As procedure will vary slightly depending on the manufacturer of the material, follow his directions carefully when adding the catalyst and dye. Stir the plastic slowly to avoid air bubbles and allow any bubbles that may form to rise to the surface before pouring. Then pour the mixed plastic slowly into the mold, Fig. 4. If the plastic requires heat-hardening, be careful not to overheat it, as overheating is likely to cause the casting to crack. Should the mold become too hot, place it immediately in the refrigerator or in a shallow pan of cold water. Castings weighing 2 oz. or more should be allowed to stand overnight at room temperature before heating.

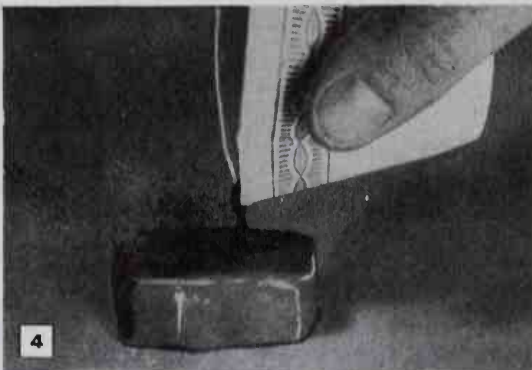
When the casting has cooled and hardened, remove it from the mold. Then clean the mold and cast a duplicate inlay so you will have one for each side of the handle.

When the inlay pieces have hardened, arrange them on the knife-handle tang and cement in place as in Fig. 5. Then allow the cement to dry thoroughly. Make a second aluminum-foil trough which will accommodate the entire handle, as pictured in Fig. 6. The trough should be $\frac{1}{4}$ in. larger all around than the size of the finished handle. This eliminates depressions in the finished handle which otherwise might be caused by bubbles forming near the foil mold.

Place the handle tang with inlays — or without inlays if the handle is to be plain — in the



When material has cooled, remove foil trough and eraser pattern from rubber mold. Note various mold designs shown above

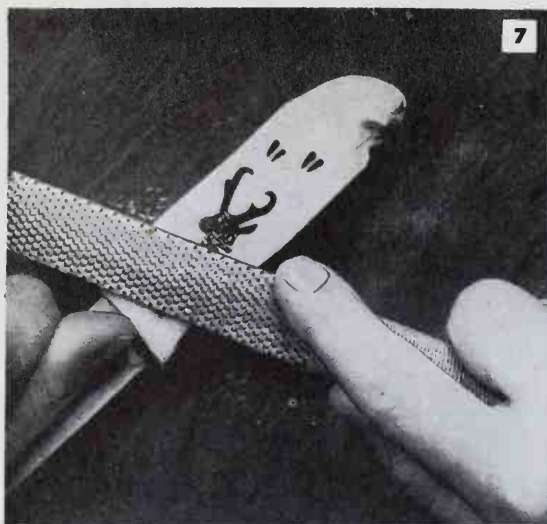


Liquid-plastic solution is mixed with catalyst and dye and then poured slowly into rubber mold, above. After hardening and cooling, inlays are cemented to handle tang, below

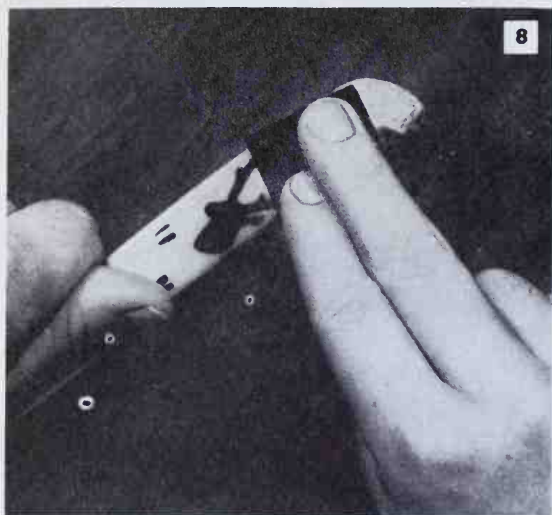


A second aluminum-foil trough is made, this time to enclose the entire knife handle. Holes and joints of trough must be sealed carefully and plastic poured in slowly, as shown below





Plastic handle is a crude block when foil is removed from it. This is roughed to shape with wood rasp or coarse sandpaper



Roughly shaped handle is given a secondary sanding with 180-grit paper and then a final sanding with 320-grit paper, as above, both sandpapers being used wet. After sanding has resulted in desired shape, handle is given final polishing with cloth

trough. Seal off all holes in the trough with cellulose tape and cement joints of the trough, as it is important that the trough be leakproof when the plastic is poured into it.

Check to see that the foil trough has not been dented to the point where it will leave an impression in the plastic. Then mix the plastic and pour it slowly into the trough as shown in Fig. 6. The plastic should cover the handle tang to a depth of $\frac{1}{4}$ in. over its top. This plastic, of course, will be of a contrasting color to that used for the inlays.

The hardening of the handle casting is considerably more critical than that of the inlays. After the plastic has jelled, it is best to leave it at room temperature overnight before heating. Then be careful that you do not heat the casting excessively. When the plastic has hardened and cooled, remove the foil trough.

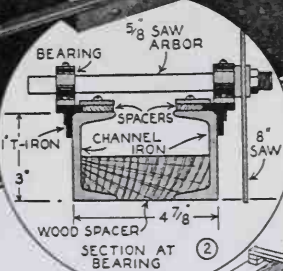
The handle at this point is a rough plastic casting. Begin working it to shape with a wood rasp, Fig. 7, or coarse sandpaper. When the handle is slightly larger than finished size, begin smoothing the surface with 180-grit wet sandpaper. Then follow with a finer, 320-grit wet paper, as in Fig. 8. Give the handle a final polishing with a soft cloth. When the masking tape is removed from the blade and handle tip, your knife handle will look much like the one pictured in Fig. 9, and it will be as rugged and durable as it is good looking.

If an air bubble should leave a depression in the plastic surface that can't be sanded out, you can patch it with plastic of a matching color. Sand with 320-grit wet sandpaper and polish to blend in the patch with the rest of the handle. ★ ★ ★

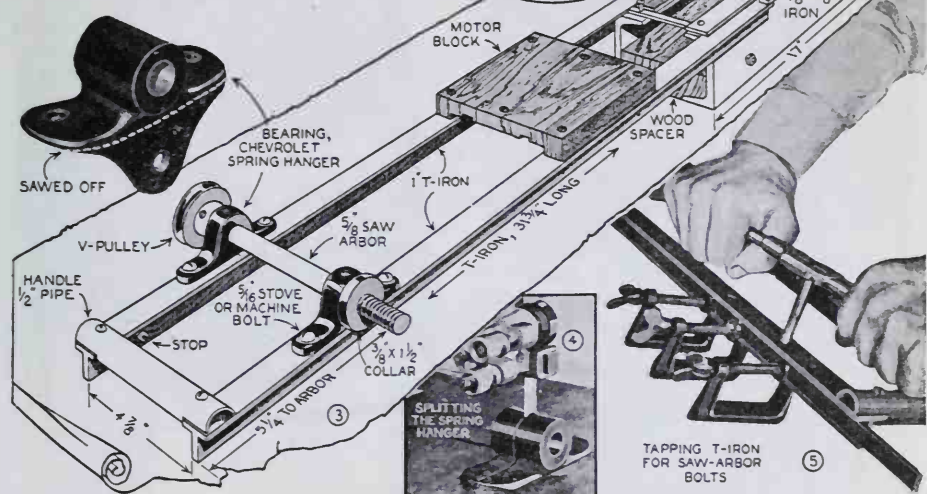


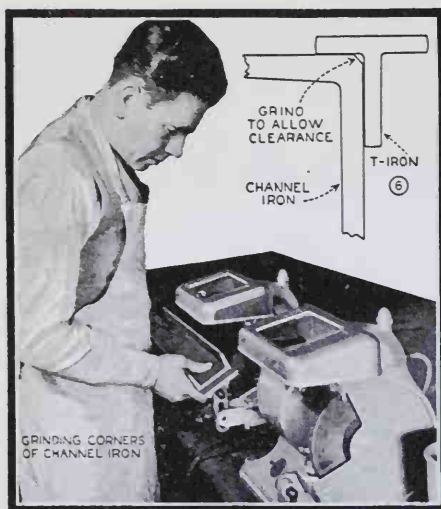
CUT-OFF SAW

SIMPLE and compact, this sliding cut-off saw operates without the overhead rigging common to power saws of this type. It will crosscut boards 14 in. wide by 2 in. thick as in Fig. 1. The whole thing consists of a base of channel iron and a sliding T-iron carriage, the latter forming a support for the saw arbor and the motor. As shown in Figs. 2 and 3, the channel-iron base pieces are held together at the bottom by means of a wood spacing block and two through bolts. Metal crosspieces at both ends on the top side of the channel maintain exact width. Wood spacers and strips of iron are bolted to the top flange of each channel to form a hold-down for the sliding carriage.



THIS SAW HANDLES WIDE WORK EASILY AND ALL MOVING PARTS ARE SHIELDED WITH METAL GUARDS





The carriage consists of two lengths of T-iron, spaced to form a snug, sliding fit on the channel-iron base and held rigidly to this width by means of the pipe handle, the rear cross tie, and the motor block. Bearings for the saw arbor are made by cutting the flange off a Chevrolet front spring hanger and then splitting the hanger into two equal parts, as in Fig. 4. The original brass bushings are reamed out to take the saw arbor. As shown in Fig. 2, the studs that hold the bearings extend partly into the sidewall of the T-iron. Consequently, in drilling and tapping the stud holes, a scrap piece of flat iron should be clamped securely to the side of the T-iron as indicated in Fig. 5, to prevent the drill or tap from "leading off."

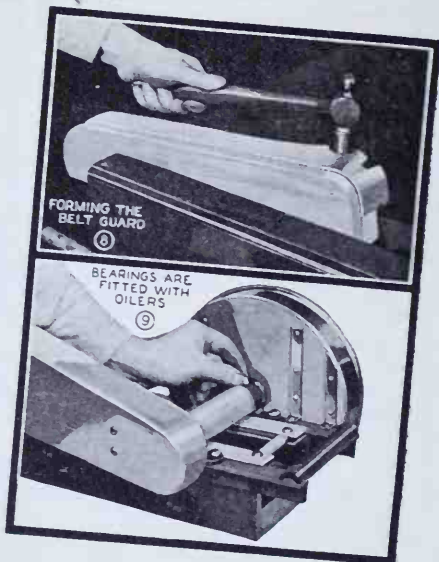
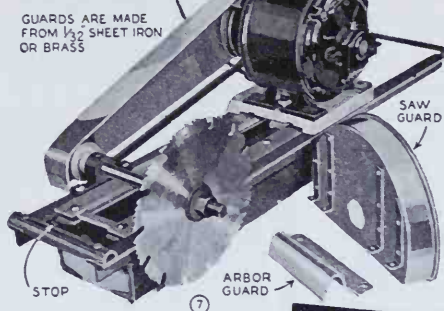
The saw-arbor collar is reamed a trifle undersize, then heated over a gas burner until red, after which it is forced over the end of the shaft and immediately quenched in water. Threads on the saw arbor are right hand. An important mechanical feature of the saw concerns the fit between the sliding T-iron carriage and the channel-iron base. The sharp outer corners of

the channel irons should be ground off, as shown in Fig. 6, so that the T-irons can ride in positive contact. Riding surfaces should be polished to minimize friction. Fig. 7 shows the saw in a closed position, a bolt through one of the T-irons striking against the channel base to form a positive stop. Blade and shaft guards are made from $\frac{1}{32}$ -in. sheet iron or brass. The blade and belt guards are hammered to shape over a wood form, as shown in Fig. 8. Both the blade and belt guard should be well braced with suitable metal strips. Fig. 9 offers a good view of the blade guard and shows the insertion of one of the oilers, which should be fitted in both bearings.

An 8-in. cut-off saw is used for this unit. The motor can be either $\frac{1}{4}$ or $\frac{1}{8}$ hp., depending upon the nature of your work.

The pulleys are 2 and 4 in. in diameter to give a blade speed of approximately 3,400 revolutions per minute.

A narrow slot is cut in the table top below the blade so that sawdust can pass through.



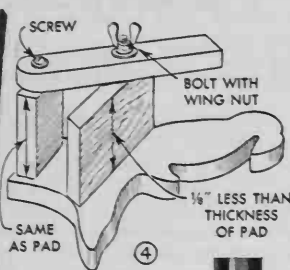


More SPEED on CUTOUTS



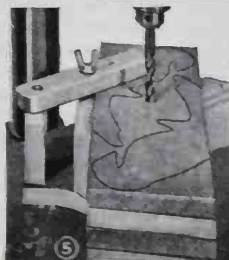
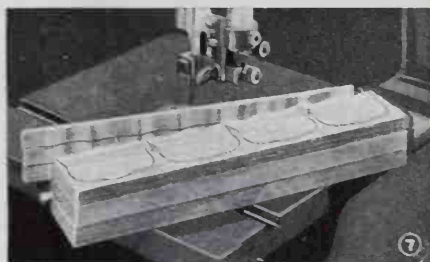
IN PRODUCING novelty cutouts for profit, the owner of a small shop must make every possible use of production methods in order to turn out work that can be sold at competitive prices.

Pad sawing: This is a popular method of producing several figures at one time by the familiar method of making a pad of the work. Band-saw work should be about 3 in. thick, and scrollsaw about 1½ in. Even where the machine has greater capacity, there is little to gain in exceeding these thicknesses. Simplest method of assembling the pad is by nailing, locating the nails in the portions of the work that will be waste stock as in Fig. 7. Two or more figures on a panel as in Fig. 3 often saves lumber, and in all cases eliminates some cutting of the original blank. For long-run work, many operators prefer to use holding jigs. The box jig in Figs. 1 and 2 is ideal for work that has at least one uncut square corner. The clamp jig, Figs. 4 and 6 can be used for any figure having one uncut edge. In making jigs of this kind, the base block is left in-the-square, being cut to shape at the same time as the



Pad sawing

should be used to cut several pieces at one time. The pad is nailed or held in a clamping jig. A 3-in. thickness is best for band-sawing





Block printing

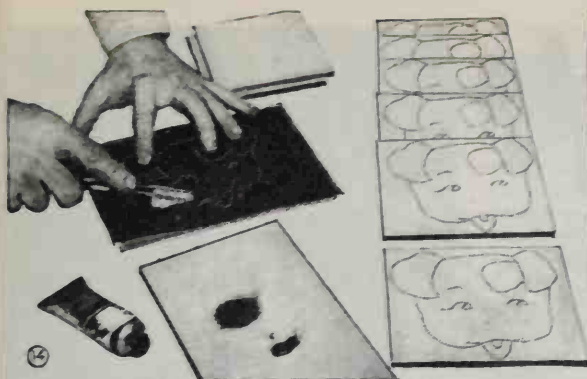
with linoleum or wood block is an excellent method of marking block detail lines. Transfer can be made by hammering or by pressure

first load of panels. Turning holes, Fig. 5, are very helpful. A check should be made to see that both drill and band-saw blade are aligned square before starting work.

Block printing: Photos in Figs. 8 to 13 inclusive picture good production methods of finishing cutouts by dip-staining of edges and block printing of detail. Fig. 8 shows the initial operation after band-sawing, the work being dipped into water stain of the same color as the paint to be used on the faces of figures. The purpose of staining is to color the edges, after which the work is face-sanded to remove any raised fibers in preparation for spray application of lacquer on the face, Fig. 9. Note the use of square sticks with fine-pointed nails as a means of holding the cutout. This is one of the simplest and best methods of handling all types of small cutouts. Black detail on the face of the figure is put in with a linoleum or wood block. The design can be transferred by hammering as in Fig. 12 if the figure is small, otherwise some simple form of pressure such as a clamp or vise should be used.

The inking pad is a piece of $\frac{1}{4}$ -in. felt glued to a wood block. Regular block-printing ink is ideal for maximum blackness but is very slow drying. Colors in Japan give slightly fainter impressions but are fast-drying and quite satisfactory. In either case, the color is used just as it comes from the tube, being rolled out on the pad with a roller or stick. Fig. 13





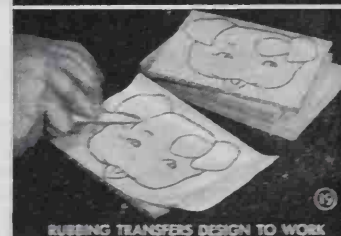
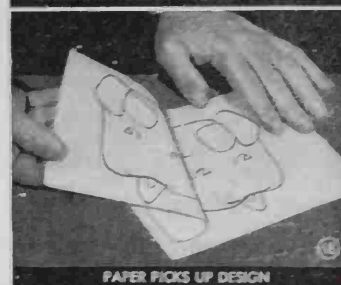
The perforated pattern

is ideal for transferring outline or pattern for hand painting. Best medium for the pattern is celluloid obtained from old photo negatives. The paint should be thick color in japan, applied sparingly

shows the finished cutout, painted thumbtacks being used for eyes. The body of the figure is not a cutout, strictly speaking, but is formed with the use of a pattern on the shaper. Note again the use of stain as a means of coloring the edges of the cat's face. This method is fast and clean, and can be used to advantage on any type of cutout. The slight grain raising of water stain is not objectionable since it helps to conceal band-saw marks, but non-grain-raising stain can be used if desired.

Perforated patterns: The perforated pattern is an excellent method of transferring designs for hand painting. Best material for the pattern is thin celluloid such as old photograph negatives. The original pencil drawing of the design is rubber-cemented to the celluloid, after which the design is perforated by drilling with a $\frac{1}{32}$ to $\frac{1}{16}$ -in. drill as in Fig. 15. The finished pattern is shown in Fig. 16. In use, the pattern is held firmly against the work while color is applied by means of a toothbrush, as indicated in Fig. 14. Use colors in japan at tube thickness and keep the brush almost dry. Do not attempt to use any type of paint or ink that is the least bit fluid. Advantages of this method are that the pattern need not be cleaned and can be used continuously for as many times as desired, it can be turned over if opposite side of cutout is to be painted, and the design takes equally well on coated or bare wood panels.

Waxed-paper transfers: This is a good method of transferring the design for short-run work. The paper used can be made by brush-coating with hot paraffin wax, but is best purchased as it is inexpensive. This paper is not the familiar waxed wrapping paper, but is a special product made for transferring designs. A pencil sketch is made first, using a soft lead pencil. The wax paper is rubbed over this, Fig. 17, and then is stripped off as in Fig. 18. Rubbing the waxed paper over the work, Fig. 19, completes the transfer. This method gives eight to ten clean impressions on smooth coated stock. The design takes poorly on bare wood, hence painting of the panels before cutting is essential.

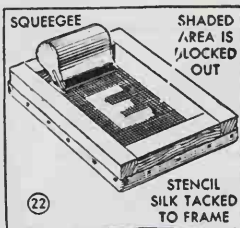
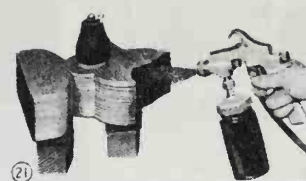


Wax-paper transfers

are used for transferring designs. The paper lifts the design from a pencil sketch and is then rubbed onto work

Hand painting: Many cutout designs consist only of a solid base color with black lines for detail. On short-run work it is advantageous to freehand the detail. Transfer methods previously described can be used for guide lines, and the painting medium should be colors in oil or japan.

Silk-screen stencils: Best of all production methods of painting is the silk screen stencil. The material is a silk cloth,

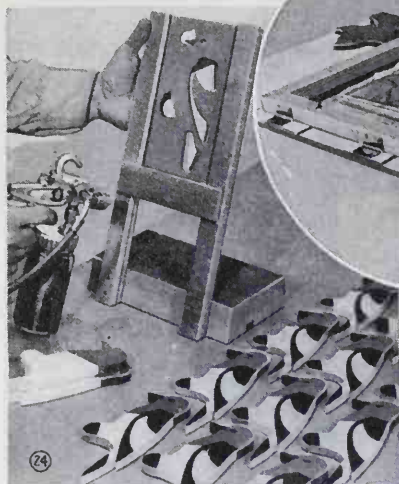


Silk-screen stencils

offer the best production method of painting. Sample illustrated shows paint-filled screen

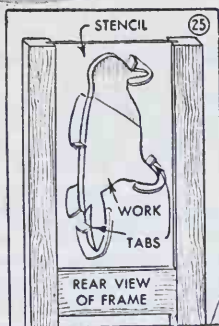
and the stencil is blocked off to leave a black margin around the cutout. The silk screen method allows many manipulations, multiple color work, photographic screens, etc. Every serious worker in cutouts should give this method a trial.

Metal stencils: Metal stencils are widely used on both short and long runs. The stencil can be made from tin, brass, zinc or other metal about .012 in. thick (28-gage). Cutting of the stencil is done

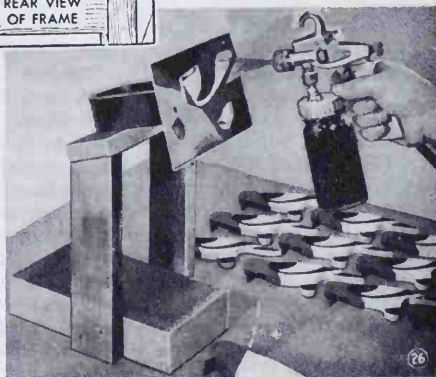


Metal stencils

can be cut out on the scroll saw and are excellent for general work. Magnet method of holding shown at right is used extensively in industrial painting of cutouts



running about 140-mesh per inch. The silk is tacked drum tight on a wooden frame, and the areas which are not to print are blocked out with a special filler. Fig. 22 pictures the set-up for stenciling the letter "E," the area around the letter being blocked out. Paint is poured on the screen and wiped from one end to the other by means of a rubber squeegee. The action of the squeegee forces paint through the silk and thus transfers the design. A typical set-up with silk screen stencil is shown in Fig. 23. The edges and face of work are first painted black, as in Figs. 20 and 21,

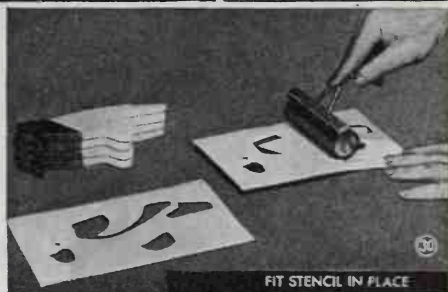
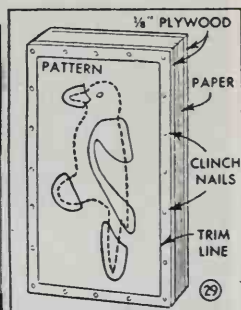




on a scrollsaw, with the metal held between plywood sheets. It is preferable to have two or more stencils of the same figure. Simplest working method is a wooden frame into which the stencil fits, Fig. 24, the work being held by hand behind the stencil, which will run seven or eight pieces before the paint starts to pile up. The dirty stencil then is thrown into a pan of lacquer thinner, and the second stencil is picked out of the thinner, brushed off and blown dry ready for use. One of the neatest methods of holding the metal stencil is shown in Fig. 26 and employs a magnet. The wood cutout is placed against the magnet and is topped by the stencil. The magnet then holds everything in place for painting. Any ordinary magnet of fair size will hold small cutouts of $\frac{1}{4}$ -in. plywood. For larger or thicker work, several magnets can be grouped together. "Magnetic chucks" of this kind, both plain and electro, can be purchased in any size and have the advantage of increased power plus off-on switch control. Whatever method is used, the metal stencil should have tabs or other locating device to position the work, Fig. 25. Obviously, if the magnet method is used, the stencil must be tin, iron or steel and not brass, copper or zinc.

Paper stencils: Plain paper stencils in several variations have many uses in cut-out painting. If paper stencils are used, it is advantageous to cut fifty or more stencils at one time by clinch-nailing the paper sheets between plywood as in Fig. 29. Tightly nailed and cut on the scrollsaw, edges will be sharp and clean. Used stencils are thrown away when dirty. The principal disadvantage of the paper stencil is the difficulty encountered in getting it to lie flat on the work. Unless firmly held, the spray gun blast will blow under the edges of the stencil. This can be minimized by using a round spray, reducing air pressure

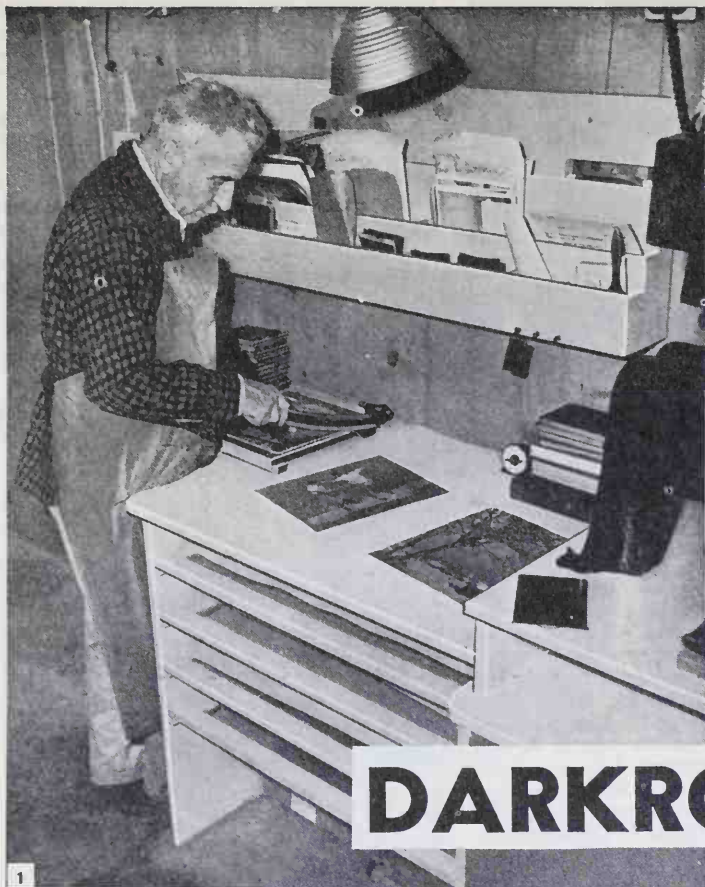
to minimum, and directing gun at right angles to the work at all times. "Blow-unders" can be eliminated entirely by using some method to actually "glue" the stencil to the work. The wax paper previously mentioned is fairly good; plain paper with dabs of wax, rubber cement or other sticky substance often can be used, or the stencil can often be held down by small weights or pins. Best of all is duplex stencil paper. This is a rubber-coated pa-



Gummed-paper stencils

provide perfect adhesion to the work and are excellent for use on long- or short-run jobs

per with strip-off backing. To use the stencil, simply strip off the backing and roll the stencil onto the work, as shown in Fig. 30. This paper has an advantage in that it leaves no deposit whatever on the work. The same stencil can be used for several pieces of work. The complete painting schedule for the figure used to illustrate stenciling methods is shown in Figs. 27 and 28. The work is first sprayed with white undercoat and then white lacquer enamel, after which the head of the figure is painted red by dipping, Fig. 28, using a synthetic to avoid stripping the lacquer undercoat. The work is now ready for the black detail, using any of the stencil methods described. If both sides of the figure are to be painted by using gummed stencils, one half of the pad should be turned over when cutting so that the cement will be on the proper side when the stencil is reversed.



In the darkroom you spend considerable time working either in total darkness or in very subdued light. Likely you know the place as well as you know the inside of your pocket but unless there is adequate storage space you may discover at a critical moment that some needed item has been mislaid. Groping for it in the dark may give you ideas about how things should be arranged. Here are good, practical suggestions that will help

DARKROOM



INVESTMENT ALONE won't make a darkroom easy to work in, but a carefully planned darkroom, even one very modestly outfitted, will enable you to save time as well as money. Also a darkroom well planned may enable you to improve the quality of your work. For example, vibration caused by a machine in the building may be fogging enlarged prints. If the darkroom is in your home, the motor of an electric refrigerator or automatic heating plant might transmit enough vibration through a floor to your enlarger to cause this trouble. Traffic on a busy street also could set up a vibration that would affect an enlarger. To prevent this, place thick pieces of sponge rubber under either the enlarger or the feet of the table on which it sets. A simple layout with all materials and equipment conveniently at hand is best. Figs. 1 to 4 inclusive are good examples.

Most photographers—amateurs and professionals alike—are inventive and resourceful. Their ideas on darkroom time-



Keep extra trays on shelves under the sink board. With this arrangement it won't be necessary to stack them one on top of the other. If you turn each one upside down it will always be dry and free from dust



Reaching for a metal pull chain on an outlet-box switch with wet hands isn't accepted practice in the safe, workable darkroom. Attach cords to switches and let them swing above your head within easy arm's reach

MADE USEFUL

savers are worth studying closely. In a few darkrooms you will see a complicated system of light switches. Some of these may be located where wet hands must grope near an electrical outlet box or reach high for a metal pull chain. Not so good, in fact, this arrangement could be dangerous under certain conditions—maybe a wet floor or faulty wiring. A better, handier and safer arrangement is shown in Fig. 4 where the lights are operated by cords attached to the switch and to the wall so that they swing at an easy-to-reach height above the operator's head. In the course of average work in the darkroom, you will often find it necessary to turn on a white light. Unless this light is shielded effectively you'll be momentarily blinded. Not only inconvenient and uncomfortable, but a serious strain on the eyes if continued for any length of time. It's a simple matter to rig shades over or around the lighting fixtures so that light will be directed upon the work.

When processing prints, it's annoying to have to fumble under the sink for the necessary trays. Build a rack for them under

the sink board where they can lie upside down, Fig. 3. That way they'll stay dry and they won't get dusty. Wastebaskets that permit discarded wet prints to drip puddles on the floor are troublemakers. A basket too small to hold an evening's quota of discards is a time waster. Get one that's big enough and make sure it's watertight. Install it under the drainboard where it's always handy.

If your darkroom "puts its mark" on your clothing, it is possible you can save expense by fastening buffers around the sink and drainboard. Measure the edges and buy towel racks, or make them of $\frac{3}{4}$ -in. dowels. Fasten to the business edge of the sink and drainboard where they will protect your clothing as you lean over the work. To further protect your clothes and to add a handy accessory, hang thick towels over the buffers by thumbtacking one end of each towel to the lower edge of the board and draping the towel over the buffer as in Fig. 2. Run a splash bead or rail around the edge of the drippy area, to prevent chemicals from slopping over onto



5—Frames screened with galvanized wire and built into the space under a table provide a convenient means of drying matte prints between blotters

6—To prop the wash tray at a more convenient height use glass jars with screw tops. Level the tray by turning the screw caps up or down

7—A windshield wiper is just the thing for squeezing wet prints. Treated in this way, prints will dry between the blotters in less than half the time

8—This hinged shelf supports a ferrotype tin while prints are being placed on it from the wash water. The drippings naturally run into the sink

9—An addition to the drainboard folds back against the wall when it's not needed. This makes extra floor space available for any other work

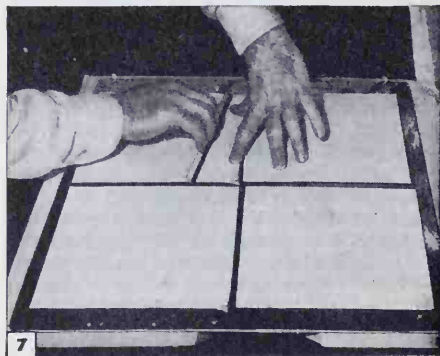
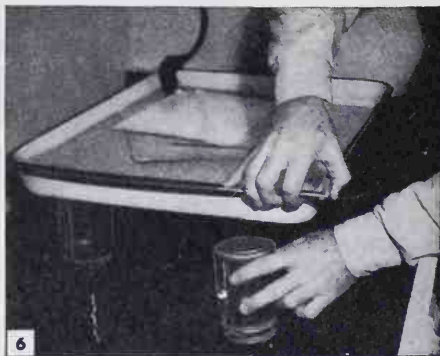
10—Plug-in outlets are a convenience, and thought must be given to the location of each one. All wiring should be installed in thin-walled conduit

11—Correct temperature for developer is important. If darkroom temperature varies, use a baby-bottle warmer. It warms the solution in a jiffy

the floor. Rubber aprons are clothes-savers, too. You'll see them in many a good darkroom. The money they save in clothing and cleaning bills can be invested toward a new print trimmer or maybe a box of matte paper.

If your darkroom has a concrete floor, you can cushion your feet by wearing wool socks and thick-soled shoes. Or better, do a little light carpentry. Nail 2-in. strips on cross-pieces, with $\frac{1}{2}$ -in. spaces between strips, to form a springy floorwalk. There's a lot of footwork in the darkroom and a little attention to comfort at floor level pays real dividends.

Many a darkroom boasts an imposing collection of thermometers, but often lacks the one that it should have. That's the one hanging on the wall near the developing tray. Air temperature acts on open trays of developer, regardless of how many heaters or chillers you may have. With a thermometer



telling you what's happening to the air temperature, it's easier to keep watch on temperatures of the stop-bath and hypo.

Those hard-working blotters deserve a place all their own. Frames screened with galvanized wire, built into the space under a table or wide shelf, provide means of drying matte prints between blotters or under blotters, Fig. 5. Then too, you can sandwich ferrotype tins between them to save the tins from accidental scratching.

Raising the wash tray a few inches above sink-board level for protection against splashing is simply and quickly accomplished by placing three or four glass jars under the tray. To level a tray on a sloping surface, put screw-top jars under it and adjust the tops until water level in the tray looks right, Fig. 6.

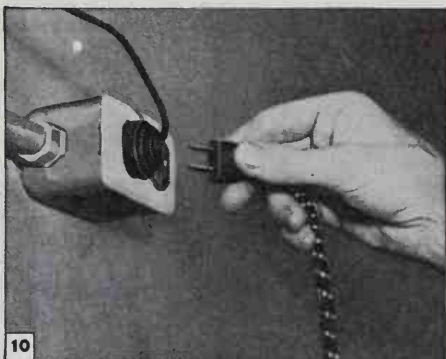
For speeding up the drying time of prints, give them a squeegeeing with a windshield-wiper blade before rolling the prints under blotters. You'll save wear and tear on the blotters and you'll keep the floor drier. Do the squeegeeing on a ferrotype tin, Fig. 7.

Slapping wet prints on ferrotype tins always has been a swampy part of photography. You can eliminate much of the dripping by building a hinged drainboard to hold the tin while you're putting the

prints on it, Fig. 8. Let it drain into the sink. A half-moon shape cut from the upper end of the board will give you a place to take hold of the slippery tin. Two screws near the lower edge will prevent the tin from sliding into the sink. Hinge the board to the wall and provide a hook or cleat to hold it up out of the way, Fig. 9.

One of the stand-by items in the average darkroom is the rubber roller for rolling wet prints under blotters. A useful, indispensable tool, but it's always in the way unless a special place is provided for it. If you build a rack especially for the roller, where it will be at hand when needed, you add workability to one more phase of darkroom routine. Electrical gadgets are used frequently and they're great time-and-trouble savers. But if you have to rig up double or triple sockets and yards of extension cord, your darkroom will have the appearance of an ill-concealed booby trap. A few extra outlets in the electrical circuit will solve the problem. Because you'll be handling the electrical equipment with wet hands, foolproof wiring is essential, Fig. 10. See that those extra outlets are properly wired and insulated. To warm the developer, try an electric baby-bottle warmer, the kind that you immerse, Fig. 11.

It's only when you have the darkroom





Left, shelves near the enlarger are handy for printing paper. Incidentally, build a platform like this to raise your enlarging easel to a convenient height. It saves a lot of squint and stoop. Above, darkroom should have housed shelf compartments. They take more time to build, of course, but you've got to "live" with the furnishings a long time, so have them handy

open or the white lights on that a good paint job on the walls, ceiling and fittings shows up. But paint regularly applied helps keep the place clean. Use flat black on surfaces where you don't want glare. Walls and ceiling can be most any color desired. It's best to use a semiflat paint rather than a high-gloss finish. Keep the painting material handy in a cabinet like that in Fig. 14.

A considerable portion of your work in the darkroom is spent in focusing the enlarging camera. Unless the easel is placed

at a convenient height, you have to bend your back and twist your neck. This kind of thing isn't permissible in the smooth-working darkroom. Take time to build a platform to raise the easel waist-high. Leave the front open, and use the former table-top as a handy shelf, Fig. 1. If your enlarger is extremely high and cramped by a low ceiling, maybe a hole can be cut in the ceiling and boxed in to admit the lamp house.

Because they are of top-heavy construction, enlargers have a tendency to wobble. A wobbly enlarger wastes time and good printing paper. Vibration can be avoided by applying sturdy braces of flat iron to the top of the enlarger column. Two extra feet will provide a wobbleproof stance. Fasten the braces to the wall or ceiling, where they will be out of the way.

Spare corners are good spots for shelves. Figs. 12 and 13. The average darkroom has sufficient space but often the furnishings are not arranged to make the most of the space available. Shelves help. Big ones or little, they are needed for storing supplies where they won't clutter up the floor. They simplify the filing problem. If you want real efficiency and have the space, build a darkroom annex to be used as a film room. It's a smaller version of the main darkroom, but limited to the loading and processing of films. It will permit two-man operation and will give your films a higher degree of protection from light, dust and chemicals. In this film annex, you can build a lot of workability into a small space. A hinged shelf will make a film-loading table.

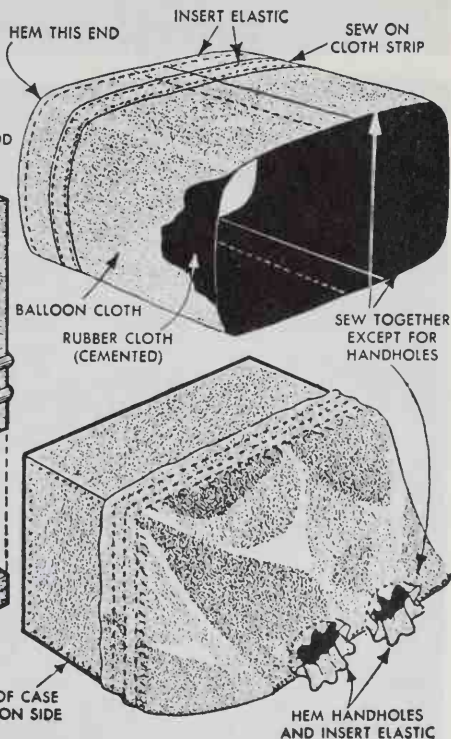
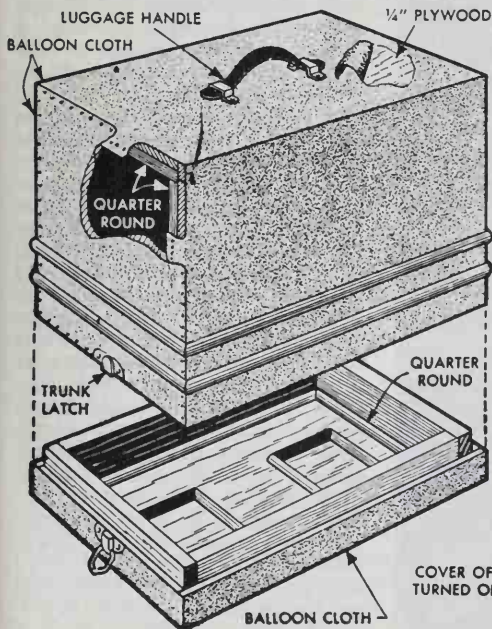
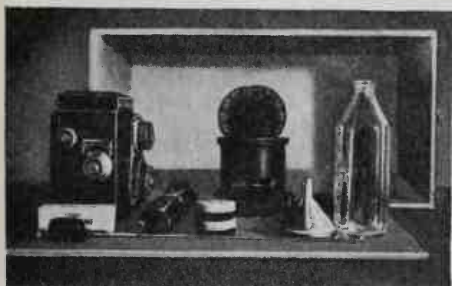


On-the-Spot DARKROOM

WHEN it is important that you come back with a picture and the chance of retaking the same shot later is out of the question, an on-the-spot darkroom will enable you to see the results right away. This portable one doubles as a carrying case for all the processing equipment needed, with room to spare for the camera. The details below show how the two-part case is built from $\frac{1}{4}$ -in. plywood and made light-tight by covering the outside with balloon cloth. Elastic in the hem around the handholes makes the trap lightproof and allows the film to be loaded into the tank without the slightest danger of fogging it.



In any photographic work requiring the developing of exposed film on the spot, a portable darkroom unit of camera-case size is an essential part of the photographer's equipment. This one provides both developing facilities and space for camera and film



DARKROOM APARTMENT

Made to order for apartment dwellers. Has everything but running water—all equipment is stored compactly in a portable, folding cabinet — ready for use



IF PHOTO PROCESSING is your hobby, but you're handicapped by lack of a handy place to work, then this self-contained darkroom should make you happy—especially if you live in an apartment. It does away with makeshift methods, saves time normally spent in getting ready and keeps everything together. Just swing open the top and bottom doors, lower the front and you're all set to begin work, with everything at hand, except running water. It folds compactly as shown in Fig. 3 for storing in a corner.

The cabinet is designed with a specific place for each item of equipment and the keyed list and drawing in Fig. 4 shows where each goes. The front of the cabinet, when lowered, provides a roomy worktable, which is supported at a convenient height by swinging open the door below it. The table forms a large working area which will accommodate three 11 by 14-in. trays, side by side, as shown in Fig. 1. A separate block of wood should be at hand to place under the "gate-leg" door to prevent the cabinet from tipping forward. Note that a standard safelight is hinged to illuminate the worktable, and that there is a handy overhead white light that can be swung out over the work. The door which supports the worktable is fitted with shelves for storage of photo chemicals as shown in Fig. 2, with additional space for other supplies in the bottom of the cabinet.

The cabinet is of simple butt-joint construction. As dimensioned in Fig. 4, it is a little over 7 ft. high. Plywood and solid stock can be combined in making it, plywood being used for the back of





the cabinet and for facing the two doors. The drawer opening in the side of the lower part can be cut out with a keyhole saw by first boring a $\frac{3}{4}$ or 1 in. hole in each corner. Notice that the legs of the cabinet are a part of the side, and that the center shelf is narrower than the bottom one to allow for the thickness of the shelf-fitted door. The surface of the worktable can be given two coats of acid-resistant lacquer, or it can be covered with linoleum. The doors are held shut with cupboard-type friction catches. A multiple outlet and extension cord should be installed in the cabinet for plugging in an enlarger and contact printer.



A—Shelf for contact printer. B—Swivel white light. C—Safelight (red). D—Electric outlet for enlarger, safelight and white light. E—Shelf for 4 by 5-in. enlarger. F—Tray storage, three 11 by 14-in. and three 8 by 10-in. G—Worktable. H—Dry chemicals, etc. J—Film tanks, graduates, etc. K—Eight pint bottles. L—Six quart bottles. M—Elastic-band straps for holding contents. N—Storage bottles, ½ and 1-gallon size. O—Photo floods, camera, etc. P—Ferrotype tins. Q—Drawer for film, film holders, film-pack adapters, small accessories

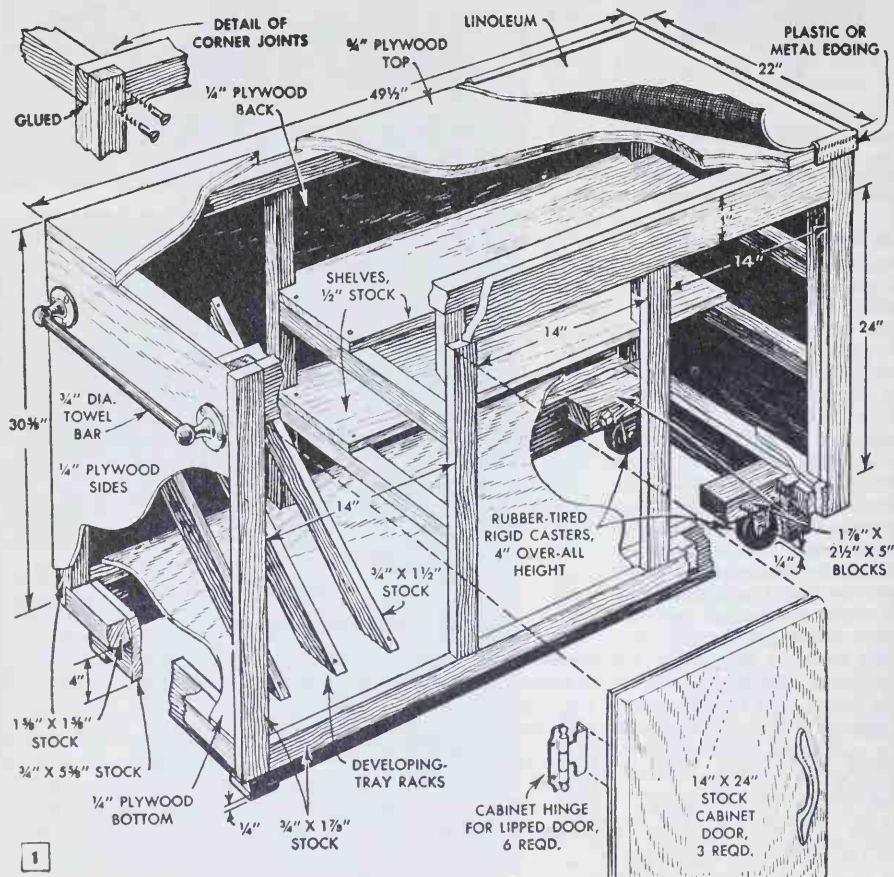
DARKROOM IN YOUR KITCHEN

WHEN a regular darkroom is not available, processing photos at home is sometimes extremely inconvenient. It's usually a case of having to work either in the bathroom or kitchen with more time devoted to getting ready and, afterward, putting things away than the actual time spent in enjoying the hobby of making your own pictures. When I moved into a studio apartment I found it necessary for the kitchen to serve as both a quick-change darkroom and a place to cook and eat. So here is what I did:

Typical overhead wall cabinets were located above the sink, and this meant that there was insufficient clearance to permit using my enlarger on a small cabinet located next to the sink. To overcome this

problem, I sacrificed the storage space of one of the overhead cabinets, removing the bottom to take the column of the enlarger and allow the lamp house to be extended to its full height. Thus, when the cabinet door is closed the enlarger is inconspicuous and the arrangement contributes considerably to the quick-changeover idea.

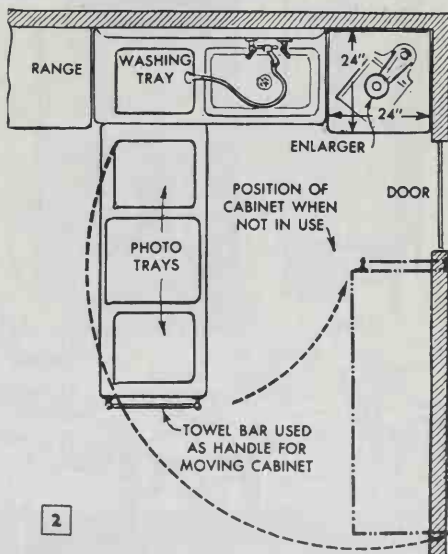
Now, the question of what to do for a work counter for my large developing trays. Limited space meant that whatever I used would have to serve a double purpose and also be located conveniently to the sink. A cabinet that could be rolled out of the way seemed to be the answer. Luckily, a movable work cabinet was already installed along an adjacent wall of the kitchen. Being 5 ft. long and having a linoleum top, it was just the thing. All I had to do was to fit it with rubber-tired casters





so it could be rolled easily into working position and back against the wall when not in use. Part of the cabinet is used for storing equipment and a towel bar attached at one end also serves as a handle. Placed at right angles to the sink, the cabinet is convenient to a safelight mounted above the sink, running water and the enlarger, as shown in Fig. 2.

If you have a kitchen arrangement where a work counter could be pushed out of the way, you can build a similar cabinet by following the details in Fig. 1. Or, a standard cabinet remodeled a little and painted to match other units in the room will serve the purpose. The cabinet shown makes use of common lumberyard stock and plywood, the top being covered with linoleum and metal edging. One end is devoted to tray storage and, although designed for three doors, one of the compartments can be fitted with drawers for storing small items. Note that only one end of the cabinet is fitted with casters so it will not roll.



Automatic Timer Attached to Face of Darkroom Clock as Reminder



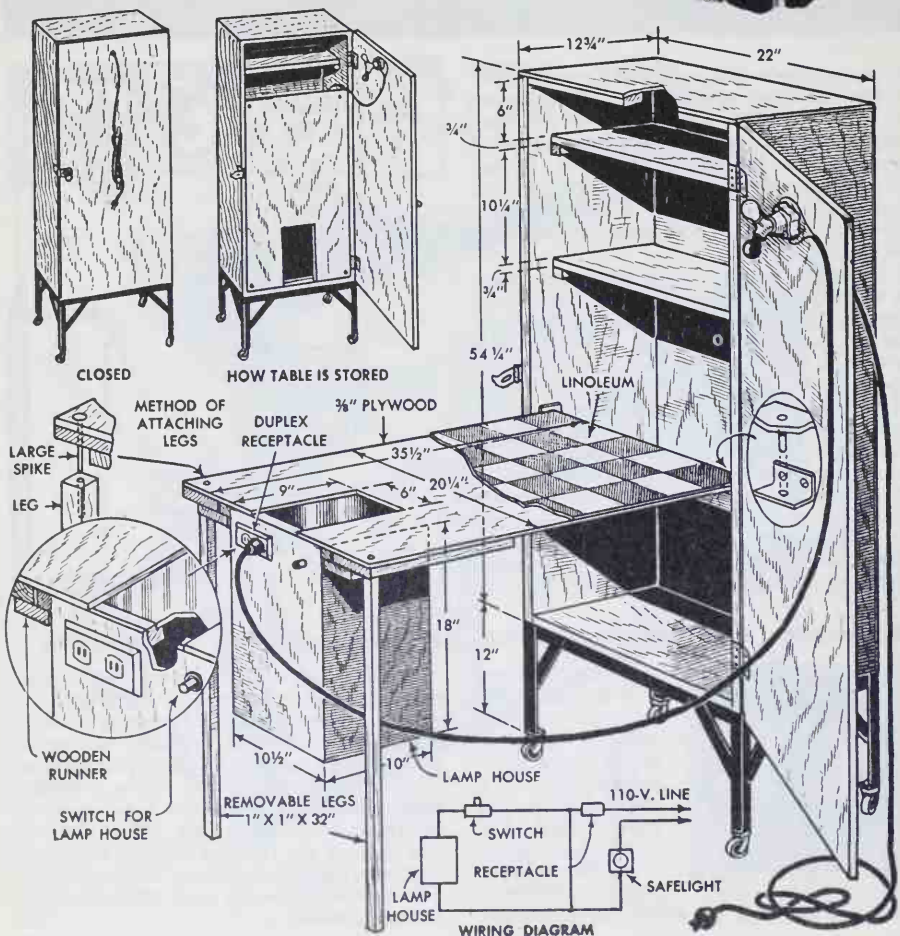
When working with fine-grain developers which require comparatively long processing time, it is easy to forget the exact time the film should be removed from the solution unless an automatic timer is used. To eliminate guesswork

when using a clock for timing, fasten a reminder hand to the face of the clock. It is simply a round cardboard backing to which a movable cardboard indicator is attached with a brass paper fastener. The backing is attached to the center of the clockface with cellulose tape and the hand is moved to the predetermined time. When the minute hand of the clock is directly under the indicator hand, it is time to remove the film. The reminder can be used similarly when fixing or washing.

timer is used. To eliminate guesswork

APARTMENT PHOTO LAB

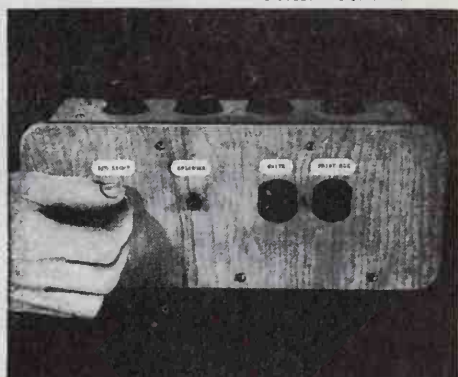
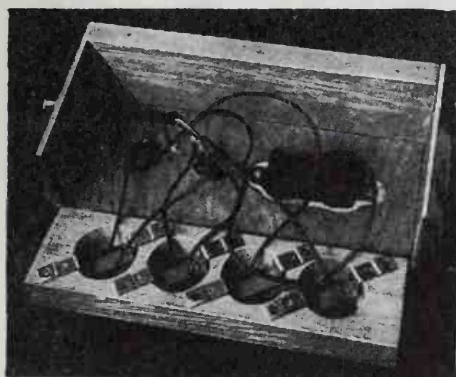
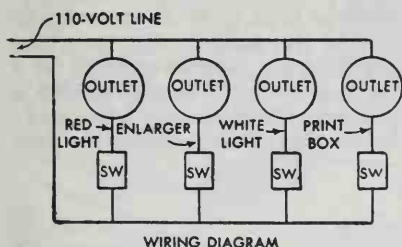
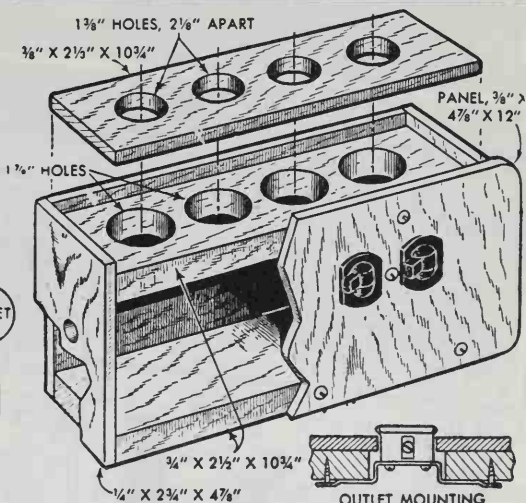
Occupying only 2 sq. ft. of floor space, this compact photo lab is the answer to the problems of the amateur photographer who lives in a small apartment. It consists of a roll-away cabinet mounted on an angle-iron base, a knock-down table, a contact printer, and a safelight. The printer and the table legs are stored in the bottom of the cabinet with the table set upright in front of them. Shelves in the upper part of the cabinet provide room for paper, chemicals, etc. The construction combines solid stock and plywood and the table top is covered with linoleum. Pins and brackets are used to hold the table in the open position and the removable legs are held with long pins. The printer is controlled independently from the safelight which remains on when the unit is plugged into the line as shown in wiring diagram.



DARKROOM SWITCH BOX

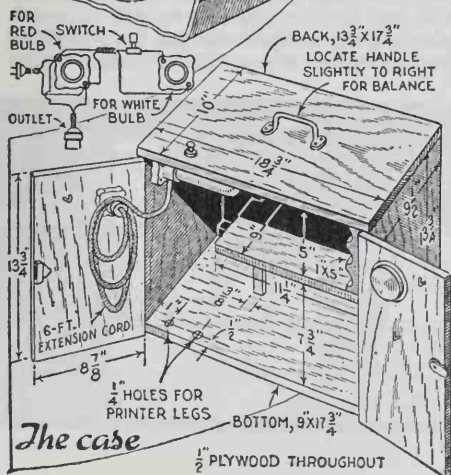
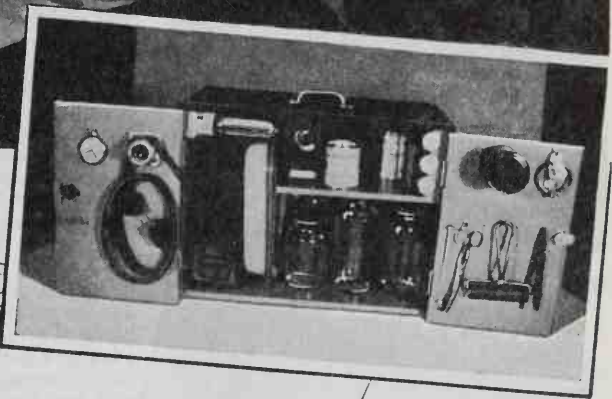
This unit groups all darkroom lighting switches on one panel and speeds up both darkroom and photographic work by supplying finger-tip control to all lighting circuits. The unit is designed for table use or wall mounting, and is easily portable for photoflood lighting as well. Outlet mounting brackets are inverted to allow each outlet to fit flush with the top of the box. Brackets are placed at an angle to conserve space. Three different kinds of switches are used so that each can be readily identified.

Wiring is done according to the diagram before the box is completely assembled. The line wire is brought into the box through a flexible-conduit connector, which is fitted with a wood reducing plug made by drilling and slotting a length of dowel. A porcelain or rubber bushing also can be used. Solder and tape all connections.



A black and white photograph of a vintage movie camera, likely a 16mm model, shown from a side-on perspective. The camera is dark-colored with a prominent silver or light-colored film magazine (printer) on top. A label 'PRINTER' with an arrow points to this magazine. To the right, a label 'PAPER HOLDER' with an arrow points to a small, light-colored rectangular component. Below the camera, a label 'FILM WINDER' with an arrow points to a separate mechanical device consisting of two spools and a hand crank. The background is a plain, light-colored surface.

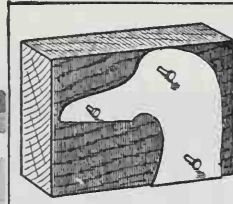
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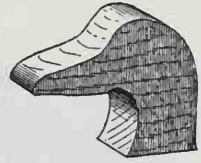
in a position to clear the former when the door is closed.

The printer, which will take film as large as No. 120, is clearly detailed in the drawing at the extreme left. The film winder, which is handy for loading cartridge reels with bulk film, and the file are dimensioned to take 35-mm. film. The roll-paper holder, consisting of a press-lid can with a felt-lined opening made in the side through which the paper can be pulled as it is needed, is held to the inside of the right-hand door by means of the can cover which is attached near the top with small screws as shown. A tin baffle soldered behind the water inlet of the film washer produces a swirling motion to remove all hypo.

DECOYS



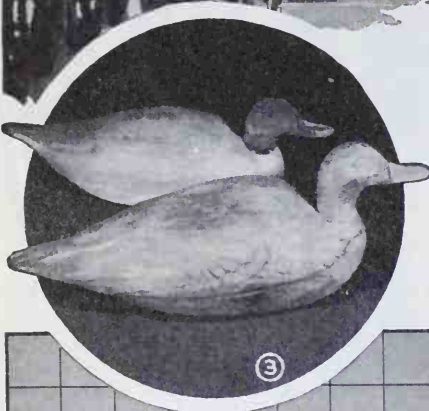
① CARDBOARD PATTERN



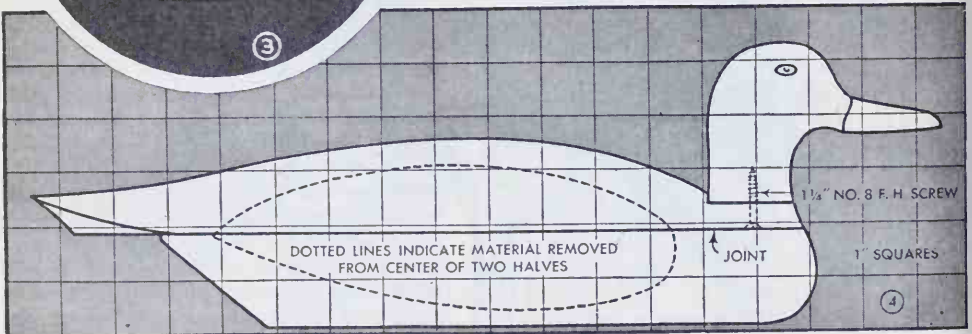
② SAWED TO OUTLINE

MAKING wood duck decoys is just another of those craft jobs which may seem difficult, but actually are very easy to do. Likely the most difficult part is carving the head, but if you cut and shape it separately and then attach it to the body, the work will be easier and you will have a better job.

Figs. 1 and 2 show the first steps. The pattern is drawn from Fig. 4 by laying off the profile of the head full size on heavy cardboard or $\frac{1}{4}$ -in. wood. Then, after sawing out the pattern, tack it to a white-pine block 5 in. long, $1\frac{3}{4}$ in. thick and 3 in. wide. A similar length of ordinary 2 by 4-in. stock is just the right thickness and width. Don't use any pieces that are knotty, cross-grained, or full of pitch. Band-saw the head to the shape shown in Fig. 2 or remove the waste in straight cuts with a handsaw. Now, after sharpening a small blade of your pocket knife to a razor-keen edge you're ready for the carving, Fig. 12. Start the cut at the edge of the wood. You will see that by starting on the original edge anywhere and making a cut you produce two other edges which in turn are cut

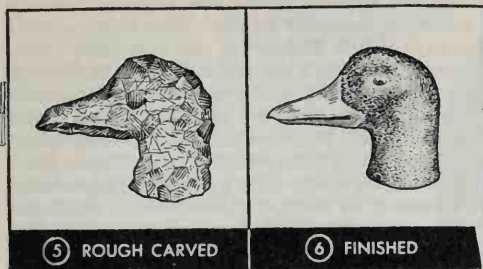


③

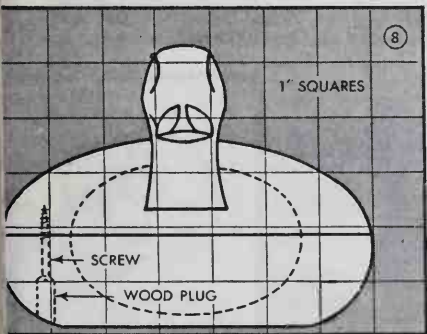
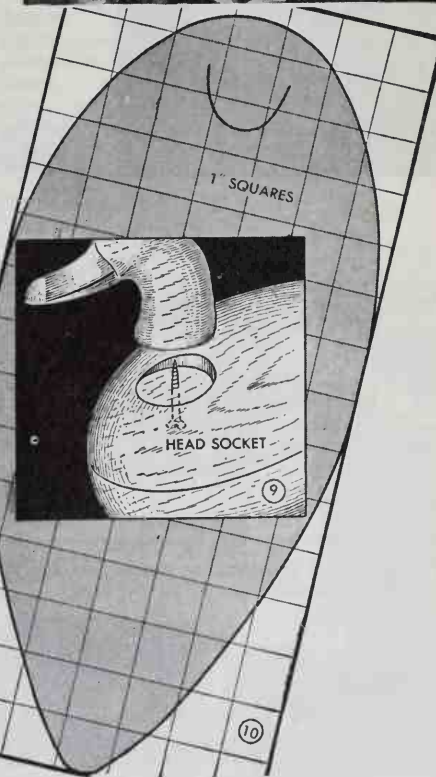


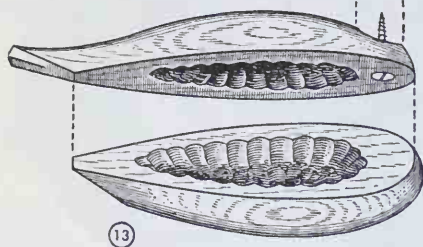
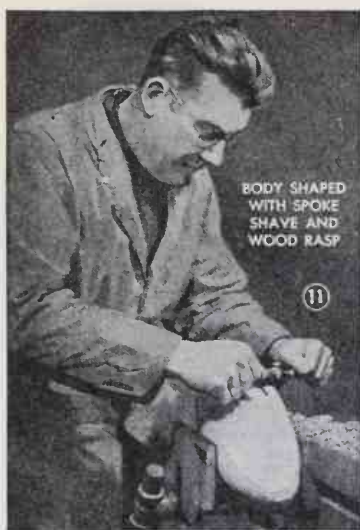
④

MADE AT HOME



down. That's the trick in carving such a shape as this. Be careful to prevent splitting at the top of the head and along the bill where the grain is straight. Make short, scalloped cuts to avoid lifting long chips. At the upper curve of the neck near the back of the head, and under the head in front, the job may be a little difficult. Merely bring these areas to a rough round shape and leave the rest to the wood rasp. After you have rounded over the corners until the curves meet at the center of the flat surfaces, and have trimmed the top of the bill to an inverted, flattened V-shape you will have the head rough carved to the stage shown in Fig. 5. Now, you start work on the body, since the head can be finished as you see it in Fig. 6 only after the body is made. Taking Figs. 4, 8 and 10 as the side, front and top views of the contours, you can make the body in either of two ways: Build it up "sandwich" fashion like the hull of a ship model from a number of pieces of stock, or make it from two pieces of $1\frac{3}{4}$ -in. stock with a hollowed center as in Fig. 13. The latter method is the best and quickest. Note from Figs. 4 and 8 that there are two pieces, the top one $14\frac{1}{2}$ in. long and the lower about $12\frac{1}{4}$ in. long. Ordinary 2 by 8-in. selected pine

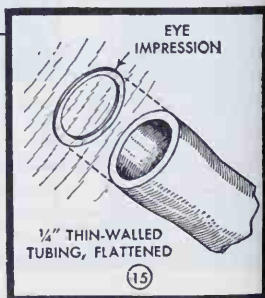
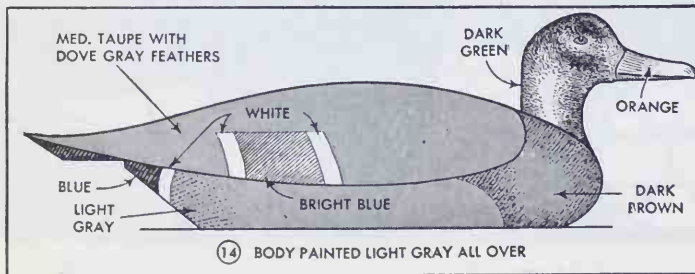




or fir stock is just right. Both top and bottom pieces are sawed to the shape shown in Fig. 10 except, of course, the lower piece is shorter, and one end is cut at an angle as in Fig. 4. Dotted lines in Figs. 4 and 8 indicate approximately the amount of waste to be removed from the halves. This is done with a gouge as in Fig. 7. If desired, you can make cardboard templates from Figs. 4 and 8 to aid in shaping the body curves. The whole job amounts to little more than rounding the curved edges with a spoke shave as in Fig. 11, but here's a point to remember: If you are making a number of decoys, Fig. 3, it's a good idea to bring them all to a finished stage, make a trial assembly of each, and then weigh them individually. In this way you can disassemble and trim out more waste from the centers to bring them all to a uniform weight. This is quite important in the full-bodied decoy.

The head is attached with a single screw as in Figs. 4 and 16, but before attaching, a socket must be formed for the neck, as indicated in Fig. 9. Be sure that the head is no higher in relation to the body than indicated in Fig. 4 as a head raised high is an attitude of alarm in live birds. Once the head is attached, assemble and finish the body surfaces with a wood rasp. Then disassemble, coat the joints with waterproof resin glue, drive home the body screws and fill the holes with plugs as in Fig. 8. No need to sand the surfaces; it is better to leave them rough in the "rasp" finish. Figs. 15 and 19 show one quick method of making a passable eye. Ready-made glass eyes can be used if desired. Practically speaking, the eyes are not at all essential.

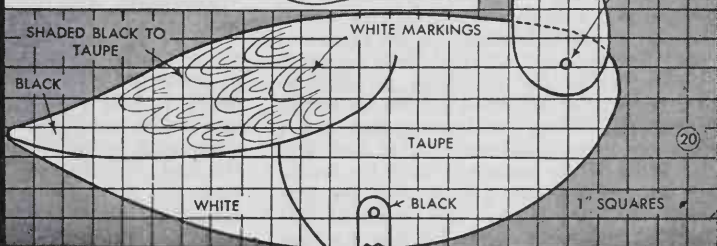
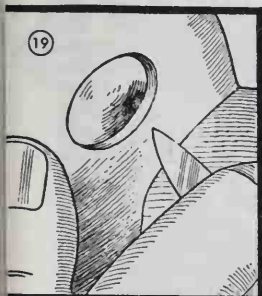
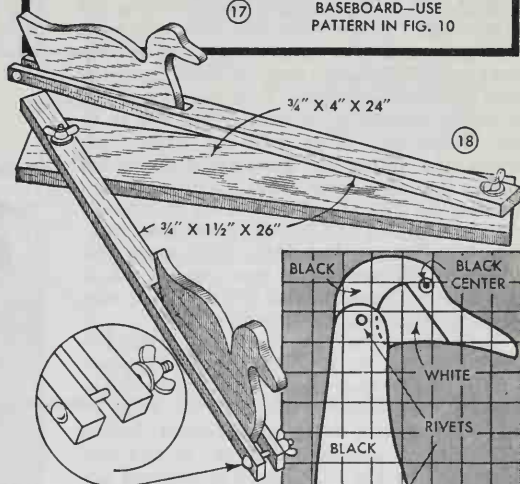
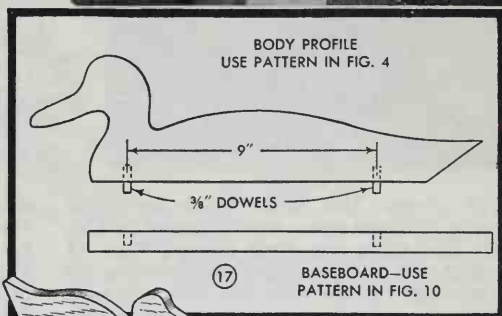
Fig. 14 gives a fairly simple color key for painting the body in simulation of a mallard drake. A good job will take time and care. If available, use japan colors over the gray ground coat. Otherwise use ordinary outside oil paints and, when these are thoroughly dry, finish with a coat of flat varnish to dull the gloss. If done carefully, this procedure results in a very natural appearing job. However, many practical and experienced wildfowl hunters consider the attempt to simulate the natural plumage colors in intricate detail as unnecessary. They prefer that their decoys be painted only in monotone variations of gray and brown, which makes it possible to use the same decoys on a number of the common

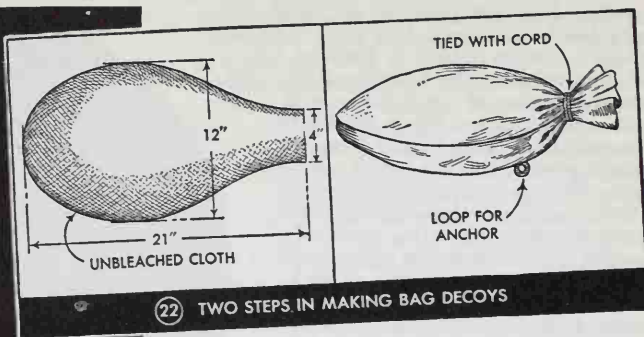
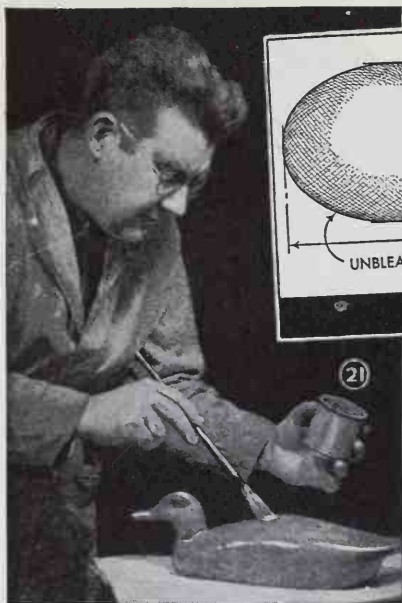


species. For this purpose the head and neck can be colored a dark green and the breast a brown which is blended into a medium gray for the balance of the body. The simulation of wing feathers is made with a lighter gray. When you blend the wet paint colors, Fig. 21, keep the excess wiped from the brush with a cloth. This particular decoy is really a "composite" simulation, larger than some common species, somewhat smaller than others, but experiment has shown it to be effective, durable, and most important, it rides rough water well. To finish, turn a small screw eye into the bottom about 4 in. back of the breast curve to provide for attaching an anchor.

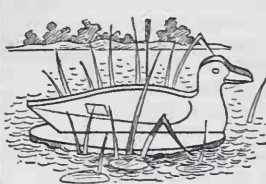
Profile or silhouette decoys are simple to make. They are effective lures and have the advantage of being light and easy to transport and set out. Figs. 17 and 23 show one type of silhouette which is loose-doweled to a base or float. To make the body, lay off a pattern, less $\frac{1}{2}$ in. from the height, from Fig. 4, and for the base a pattern from Fig. 10. Transfer outlines to $\frac{3}{4}$ -in. stock and saw in the usual way. Some makers use $1\frac{1}{8}$ -in. stock for the base. Dowels are glued in only one of the members so that the parts can be separated and carried flat. Fig. 18 shows another version, a folding affair which is exceptionally handy. Slots are cut in one end of each arm to take silhouettes band or scrollsawed from $\frac{3}{4}$ -in. stock. Again use the profile in Fig. 4, but add about $\frac{1}{2}$ in. to the height of the body. Use $2\frac{1}{4}$ -in. bolts with wing nuts to provide adjustment in the arms and hold the silhouettes.

Next comes the silhouette goose decoy, a "collapsible" affair with folding head and leg. A 21-in. length cut from a $\frac{3}{4}$ by 8-in. board and band or scrollsawed to pattern serves for the body. Head, neck, and leg are separate pieces attached to the body

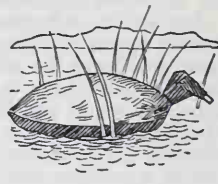




22 TWO STEPS IN MAKING BAG DECOYS



23 SILHOUETTE DECOY



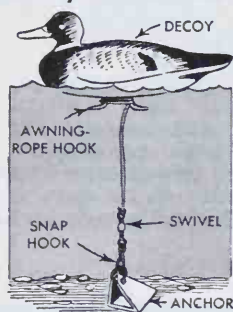
24 BAG DECOY

with rivets. Use $\frac{1}{2}$ -in. stock for these parts. Colored areas are indicated in Fig. 20. The silhouette duck decoys, Figs. 17 and 18, are best painted a medium gray all over with a green head and brown breast, the latter color blended into the gray. To make representative eyes on both the duck and goose silhouettes, first paint a small area an orange color where the eye is to be. When dry, draw a $\frac{1}{16}$ -in. circle with india ink. Bring the head color up to the inked line and paint a black center as indicated in Fig. 20. The eye on the goose decoy is somewhat larger. Both are "conventional" eyes but they will serve the purpose. Remember, if you use oil paints for either of these jobs to finish with a coat of flat varnish to kill the gloss.

Last comes the bag decoy and that's literally what it is. A crude affair to be sure, but very effective; in fact it is quite widely used by experienced hunters. To make it, cut two pieces from unbleached cotton cloth (some use light canvas) to the size indicated in Fig. 22. These are sewed together with a double seam, then reversed, and the resulting bag stuffed, the open end being tied with a stout cord. Sew a loop to the underside for attaching an anchor. Ordinarily, the material known as kapok is best for filling, but lacking this, cedar shavings or upholsterers' curled hair will do. Most of the materials used for treating canvas will serve very well for waterproofing the cloth. Two coats of linseed oil will serve nicely for this purpose. Coloring the cloth body can be done in the

same way as described for the full-bodied wood decoy, using oil paints or japan colors. With a spring clothespin for a bill, Fig. 24 shows about what you get, unimpressive perhaps in a closeup, but from a "duck's-eye" view quite effective.

Decoy Anchor Line Is Nontangling



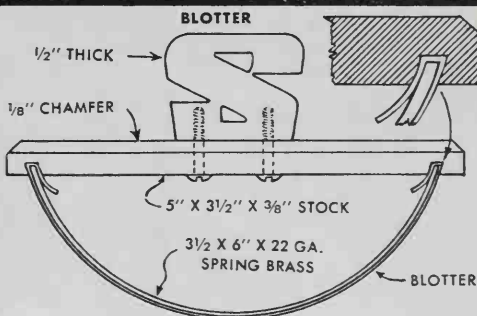
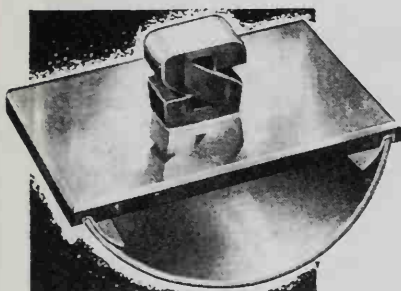
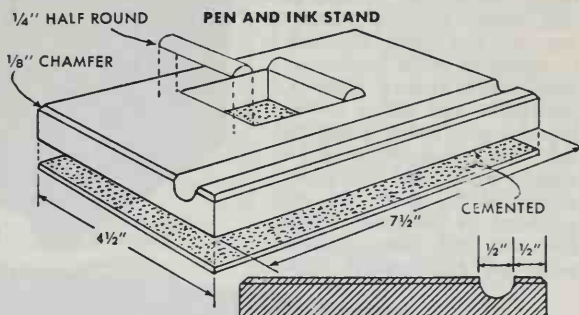
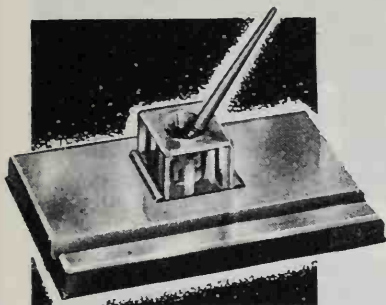
Every wild-fowler who has coiled icy anchor lines around slippery wooden decoys will welcome using an arrangement of the lines which simplifies the disagreeable job of picking up decoy sets. To make this arrangement, screw an awning-rope hook

to the bottom of each decoy, being careful to center it. If off-center, it will cause the decoy to ride unevenly. Wind the anchor line on the awning hook and then attach a snap hook to the swivel at the free end of the line. When you set out the decoy, just snap the hook over the anchor ring. In taking up the set, release the anchor and wind the line on the hook. There's no tangling and breaking of the lines.

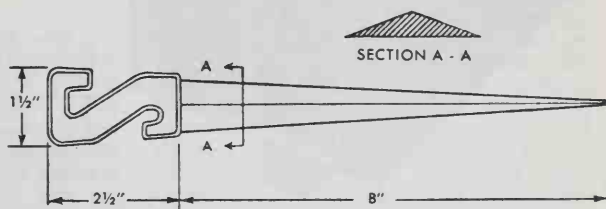
Colorful Desk Set from Plastic

HERE ARE three attractive projects: either when used individually or combined to make a distinctive, initialed desk set. All pieces are made from plastic, the sheet, rod and tubular forms being required if all projects are made. Although any color may be used, combinations of red and green, and blue and yellow are especially attractive. Base pieces of the inkstand and the blotter are made from $\frac{1}{2}$ -in. and $\frac{3}{8}$ -in.-thick plastic respectively. Angle slots cut in the base of the blotter take the ends of a piece of flat spring brass which forms a backing for the blotting paper as indicated in the sectional view. The brass backing should be buffed to a high polish

and lacquered to prevent tarnishing. Circular grooves, such as those in the inkstand are attractive when rough-cut with a fine round file and finished smooth with 8-0 sandpaper. Then they are polished by charging a cloth buffing wheel with rouge. Cement green felt to the bottom of the inkstand to prevent scratching the furniture. Letters are cut to the rough form with a jigsaw or coping saw and are finished with a fine file. A nail file is just right for this job. The sawed edges are chamfered and polished, care being taken first to remove all saw and file marks. The letter, which forms a handle, is attached to the back of the blotter with screws.

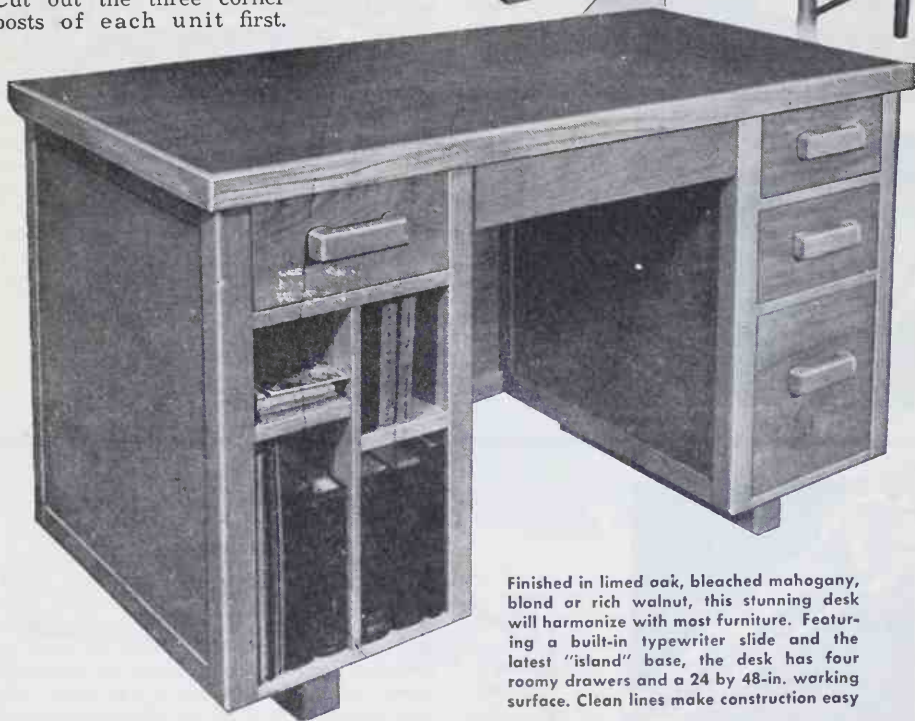


LETTER OPENER

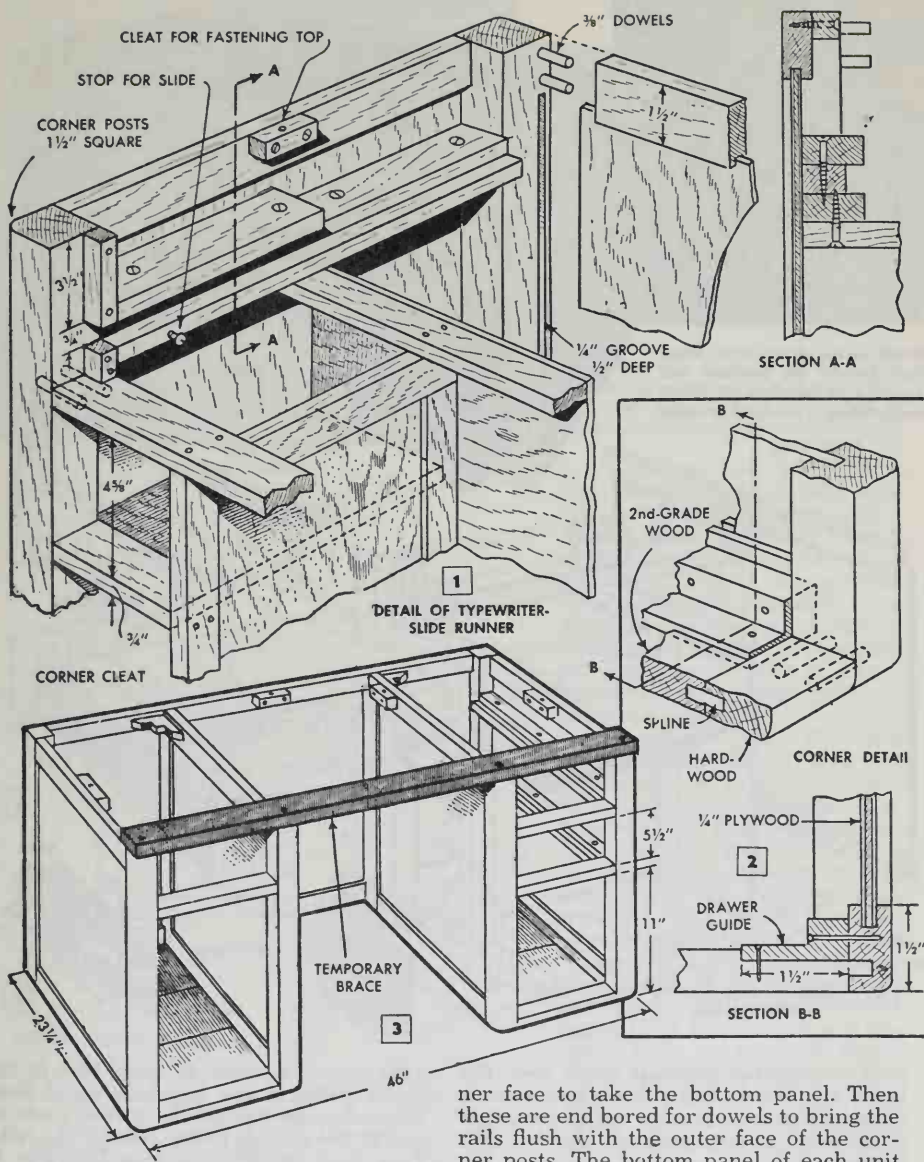


DESK with KNEE ROOM

HERE is the desk you've been waiting for—a big roomy one, good looking, with built-in typewriter slide, and designed to harmonize with both modern and traditional furniture. What's more, it is very easy to make. Ends, front and top are plywood, hardwood faced, which can be had in oak, birch, walnut, mahogany, etc. The rest of the desk is made of solid hardwood stock with inner shelves, partitions and other unexposed parts being made of soft and less expensive wood. Both end compartments of the desk are assembled as separate units. Cut out the three corner posts of each unit first.

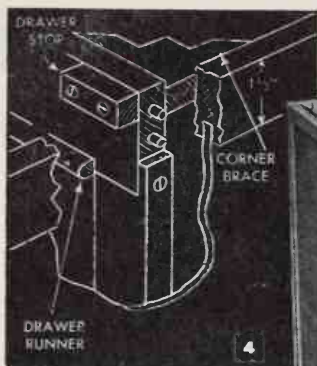


Finished in limed oak, bleached mahogany, blond or rich walnut, this stunning desk will harmonize with most furniture. Featuring a built-in typewriter slide and the latest "island" base, the desk has four roomy drawers and a 24 by 48-in. working surface. Clean lines make construction easy

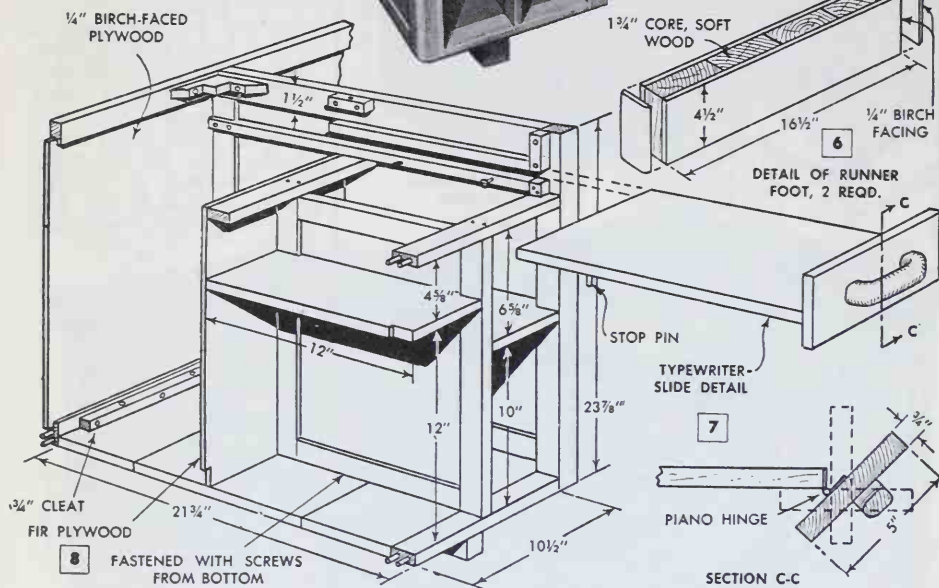
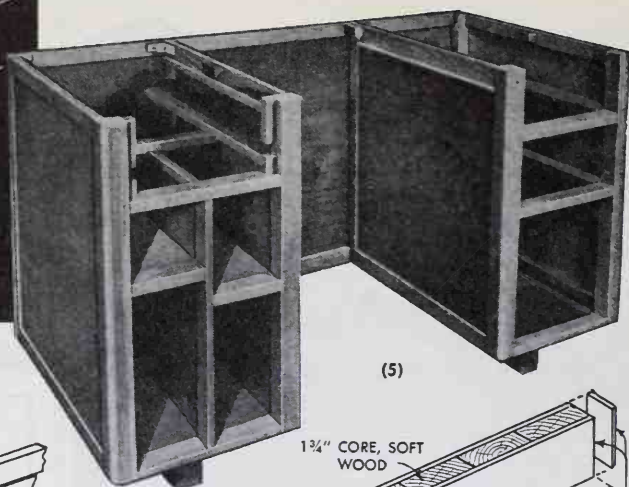


These are 1½-in. square stock and are grooved lengthwise for ¼-in. plywood. Note that the grooves are run ¼ in. in from the outside edge and that they are stopped 1 in. from each end for dowel joints. The rear posts of each unit are grooved on one face only, whereas the others are grooved on two adjacent faces. All end rails are edge-grooved for the plywood panels, the lower ones also being grooved on the in-

ner face to take the bottom panel. Then these are end bored for dowels to bring the rails flush with the outer face of the corner posts. The bottom panel of each unit is made up of soft wood and the front edge is faced with a hardwood rail. The bottom panel of the right-hand unit differs from the other in that a shallow groove is run along each edge for an L-shaped drawer guide, as detailed in Fig. 2. The outer corners of all posts and the lower edge of all bottom rails are rounded ½ in. The panels of the knee-hole are made the same size as the end panels, except that the edge which butts against the front panel is edged with



Detail above shows how knee-hole panels are notched and doweled to front panel. Note corner brace is screwed to inside



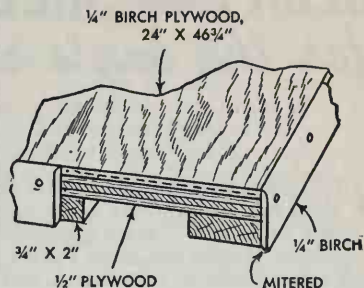
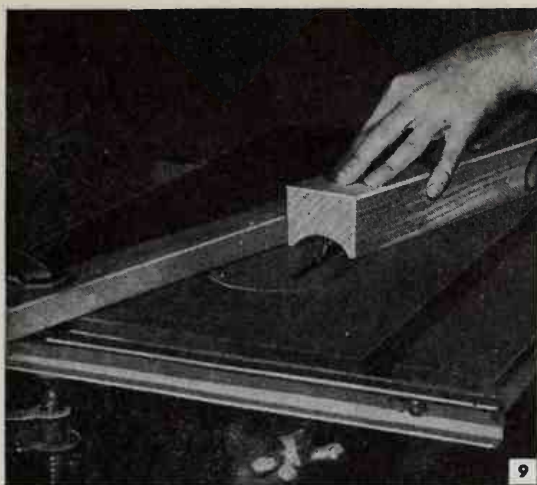
SECTION C-C

a 3/4-in. member notched to fit over the lower rail, Fig. 3. Fig. 4 shows how a notch is formed at the top, after which the piece is doweled to both rails at the top and bottom.

Start assembling the parts by gluing and clamping together the rear ends of the units. Follow this by gluing and clamping the outer end panels to them. When this is done, place a brace diagonally from post to post and nail temporarily to hold the assembly square while the glue is drying. Next, put in the dustproof bottom panels and then add the knee-hole panels. Finally, glue and clamp both assembled units to the

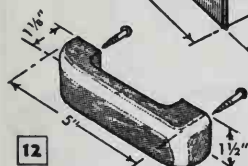
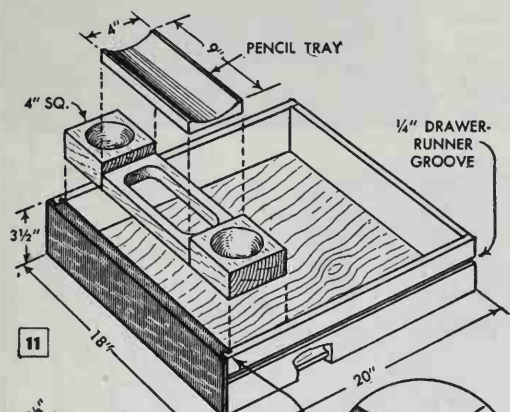
front plywood panel. In doing this, fit the dowel joints of the knee-hole panel first. When dry, spring out the corner posts to engage the dowels in the ends of the rails. Your desk should now look like Fig. 3. Note that a temporary wooden brace is placed across the two units to hold the assembly square.

Fig. 8 details the book compartments for the left-hand unit, and you'll notice that these do not extend the full depth of the unit. Here, the shelves are edge-faced with hardwood as before, the facing strips being fastened to the posts with screws driven from the underside and at an angle. Figs.

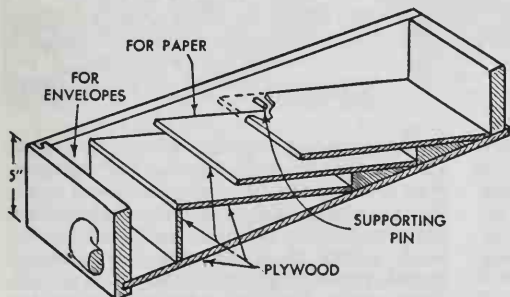


10 HOW TOP IS BUILT UP

Here is how the thickness of the top is obtained. Two thicknesses of plywood, plus $\frac{3}{4}$ by 2-in. battens, form core which is faced around the edge with $\frac{1}{4}$ -in. hardwood



12 DRAWER HANDLE, 4 REQD.



13 SECTION THROUGH PAPER DRAWER

1 and 8 show how the guide is installed for the typewriter slide which folds up to represent a drawer when not in use. Section A-A shows how three strips placed on top of one another form a channel for the slide. Construction of this varies slightly when installing it on the opposite side, as shown in Fig. 8. Fig. 7 details the slide itself and how the front is hinged.

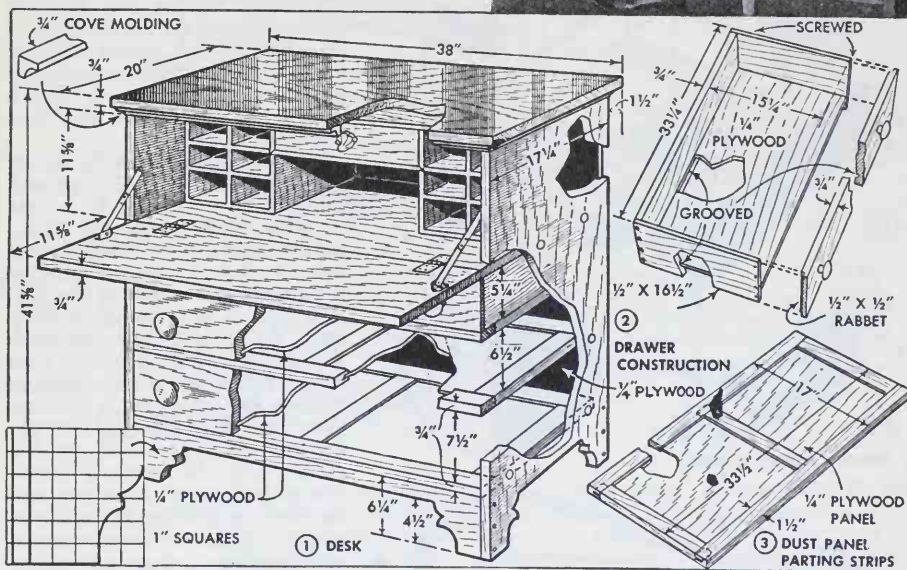
Next come the bases. These are of the popular "island" type and are built up as in Fig. 6. A core of softwood is faced with $\frac{1}{4}$ -in. hardwood and then counterbored holes are made through the core for attaching the base to the bottom and in the center of each unit. At this point the desk should look like Fig. 5. This brings you to the construction of the top, Fig. 10, which is built up of two panels of plywood, one being of $\frac{1}{2}$ -in. fir plywood, and the other $\frac{1}{4}$ -in. hardwood faced. These are glued together and backed with five $\frac{3}{4}$ by 2-in. strips, which run lengthwise to add thickness and provide a gluing surface for a $\frac{1}{4}$ -in. edging.

The drawers are detailed in Figs. 11, 12 and 13. The center drawer has no handle. Grooves cut in the side of the drawer, ride over runners which are bradded to the sides of the kneehole panels. Fig. 9 shows a method of cutting the pencil tray by repeatedly passing the work across a rotating saw blade at an angle.

DESK and SHELVES for the boy's room

THIS combination desk, clothes chest and shelf has a drop front which serves as a writing table and hides a pigeon-hole unit for storing pencils, ink, paste bottles, crayons and other items of stationery, and even a secret compartment for personal papers and letters. The shelf unit will hold textbooks, paper and other material too bulky for the smaller desk compartments. Moreover, though the shelf forms a pleasing counterpart to the desk, it is entirely separate and can be removed and hung on a wall in another part of the room if desired.

Ordinary white pine will do for both desk and shelf units if they are to be painted, but knotty pine left in natural finish looks especially attractive in a boy's room. Or, the



wood can be given a slightly silver cast called "pickled pine," obtained by giving the wood a wash coat of white shellac followed by a light maple wiping stain applied over it, and rubbing the entire surface with liquid wax to which some rottenstone has been added. The rottenstone will catch in the knots and bring them out clearly.

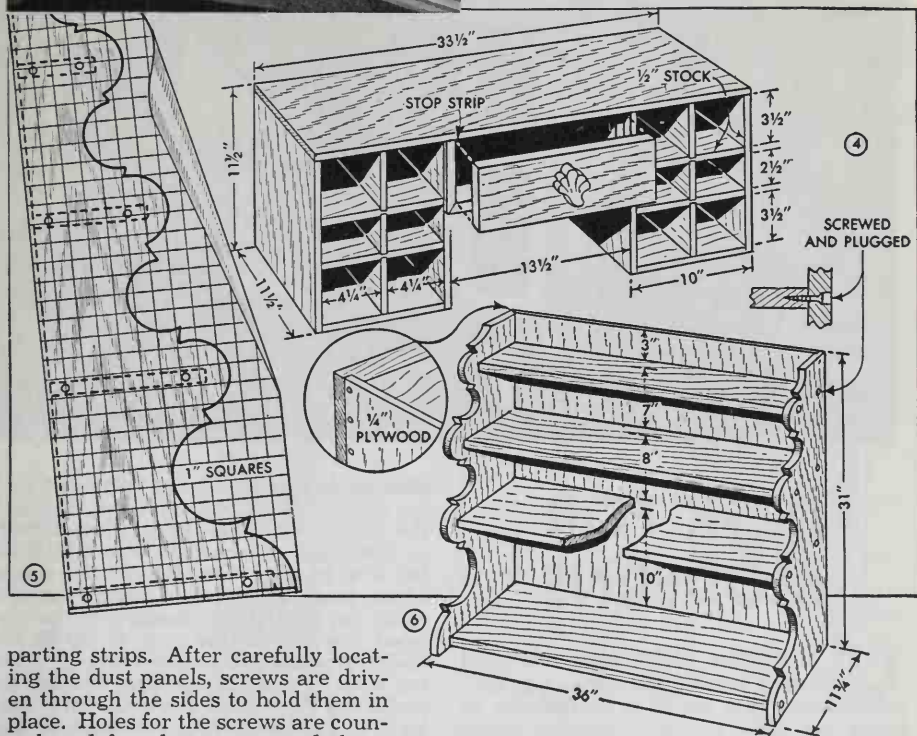
The desk top, sides and writing lid are

made by gluing together several boards to the widths shown in Fig. 1. The foot pattern is cut in the two side pieces and in the front apron according to the scaled pattern, after which the sides are rabbeted for the back, which is plywood or hard-pressed board, preferably the former if available. Next, make the dust panels between the drawers as shown in Fig. 3. The ends serve as drawer guides and the fronts as



by strips of light molding. The secret compartment occupies the middle space, the cover being held in place against the stop strip simply by means of its snug fit. Next, the top of the desk is fastened to the sides by screws covered by concealing plugs, after which cove molding is run under the projecting edge of the top. The writing lid is hinged and the folding supports are attached. These may be taken from an old desk or fashioned from pieces of metal. In fact, lengths of chain will serve equally well.

For the shelf unit, Fig. 6, use $\frac{3}{4}$ -in. stock to match the desk. Jigsaw the sides according to the pattern, Fig. 5, and rabbet the edge for the plywood back as shown in the circular detail. The shelves are of different widths from the wide one



parting strips. After carefully locating the dust panels, screws are driven through the sides to hold them in place. Holes for the screws are counterbored for plugs to conceal them.

Drawer construction is shown in Fig. 2. The side, back and front panels are grooved to take a plywood bottom, the front panel is rabbeted at both ends to fit between the sides, and then all four pieces are screwed together. For drawer pulls you can use large wooden knobs about $2\frac{1}{2}$ in. in diameter by $1\frac{1}{4}$ in. thick. These are used also on the drop leaf. The pigeon-hole unit, Fig. 4, is built separately from $\frac{1}{2}$ -in. material, then set in place and held

at the bottom to the narrow one at the top. Screws holding the shelves are covered with plugs like those in the chest. As a decoration, prints, decalcomania transfers or other colored designs of suitable size and shape can be applied to the back panel of the shelf unit.



DESK FOR MODERNS

THIS MODERN DESK combines good design with several interesting and useful features that adapt it exclusively to home use. One pedestal provides ample drawer space and the other one consists of a small open-front bookcase and a built-in wastebasket. The latter is a feature of special decorative and practical value in small homes where space is limited. The construction of each pedestal is almost as simple as that of a box and, owing to the type of assembly, nearly all joints and fastenings are concealed. Begin construction by making the top first. The edges of the top are curved as in Fig. 2 and the first thing to do is rip out the edging strips from

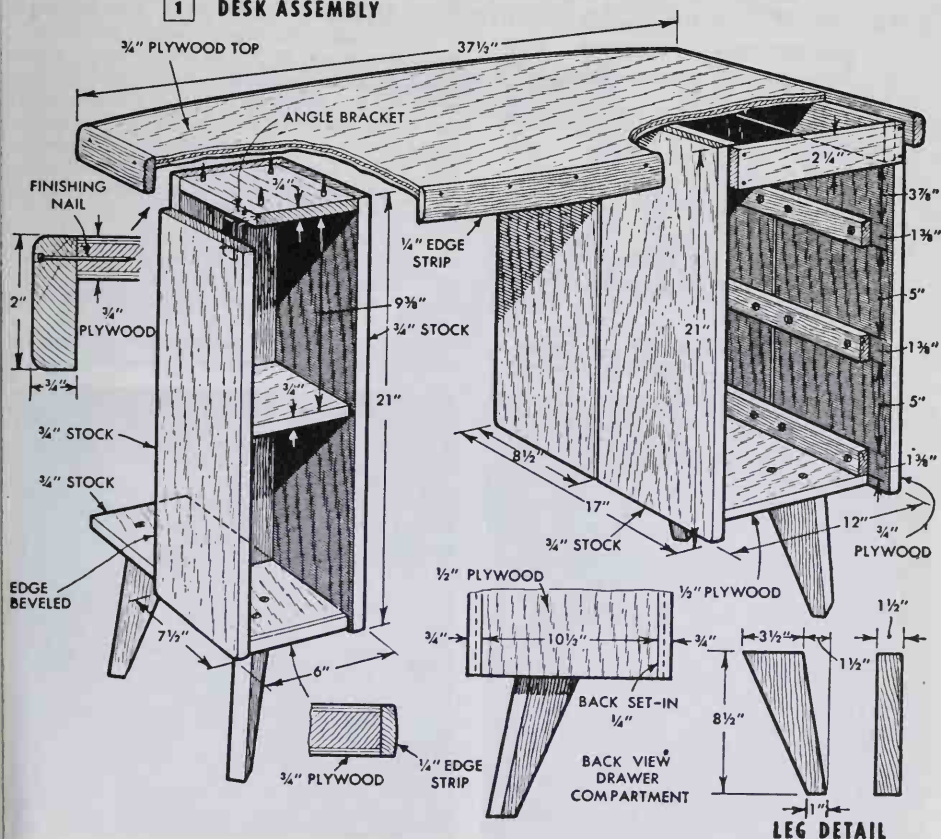
striated, or "comb surfaced," plywood. Then lay off the length and the three widths of the top from a center line drawn directly on the sheet of plywood from which the top is to be cut. Now, lay out the curved edges, using the plywood edging strips to strike the arcs. Drive brads into the plywood just outside the ends of the 16 and 18-in. dimension lines of the layout. Place the ends of the edging strip against the projecting brads and draw the strip outward until the curvature is slightly past the end of the 20-in. dimension line, as in Fig. 2. Then strike the arc with a pencil point held against the inner edge of the strip. Do the same on the opposite edge of the top. Saw outside the layout lines along the curved sides and across the ends, and then true the edges with a plane to the layout lines. Note that the trim pieces on the ends are of $\frac{3}{4}$ -in. striated plywood while those along the sides are only $\frac{1}{4}$ -in. plywood. Note also that these parts overlap at the corners. Attach the endpieces

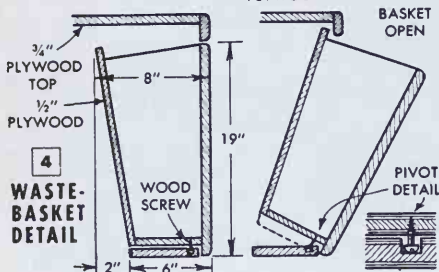
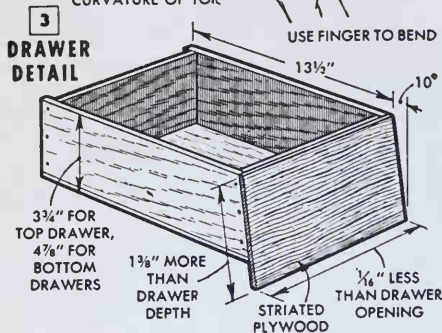
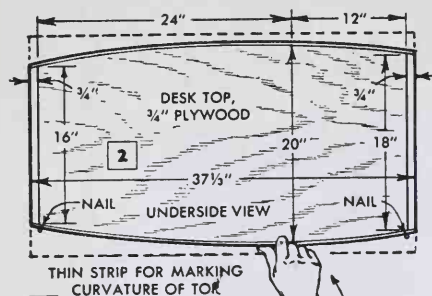
Both the drawer pedestal and the open bookcase are of simple box construction with butt joints fastened with glue and screws. The back panel of the drawer pedestal fits into ¼-in. grooves cut in the inner and outer side panels. Cleats are attached to both side panels with glue and screws to serve as braces and drawer runners. A ¼-in. groove about ½ in. deep divides the inner and outer panels vertically so that the effect is that of two separate panels on each side.



Back view of desk shows how built-in wastebasket tilts outward. It is easily removed from the desk for emptying and cleaning.

1 DESK ASSEMBLY





Drawer fronts of striated plywood are inclined at an angle of 10 deg., making rails unnecessary

Edges of the groove are rounded slightly before assembly of the parts. Another important design detail is the manner of attaching the top rail, Fig. 1. The ends of the rail are attached to cleats screwed to the side panels and the ends of these cleats come within $\frac{3}{8}$ in. of the front edges of the side panels. Thus when the rail is screwed in place the corners project about $\frac{3}{8}$ in. The corners are then rounded as in the photo below Fig. 4. No bottom rail is necessary because of the design of the drawers, Fig. 3.

Now, note the short outer panel which forms one side of the bookcase, Fig. 1. The outer edge of the panel is supported by an angle bracket and the corner is rounded. This also is a design detail as it gives the effect of separation which you will note in the photo above Fig. 1. This simple design motif is characteristic of modern furnishings of this type. Invert the top on a table or bench and attach the pedestal and bookcase with screws. Be careful to get the parts correctly positioned. Make and attach the four legs in the positions shown. Glue strips of matching wood to the front edges of the bookcase shelf and bottom.

Next, make the wastebasket to the dimensions given in Fig. 4, using $\frac{1}{2}$ -in. plywood for the back and sides and $\frac{3}{4}$ -in. plywood for the front. Round the edges of the front panel to match the corner contours of the outer bookcase panel. Note in Fig. 4 that the back of the wastebasket is extended so that it engages the edging strip across the end of the desk top when it is tipped forward. The basket pivots on the heads of screws which are driven about half their length into the bottom of the basket at points equally spaced from the

End view of the desk with wastebasket removed. End panels of basket and bookcase are shaped to match



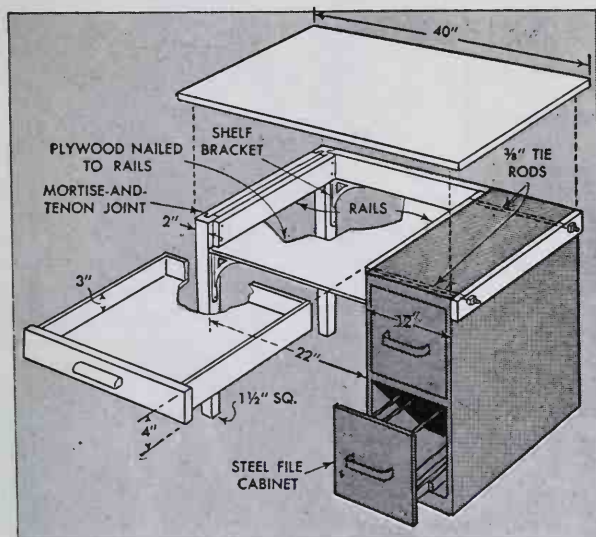
front panel. Registering holes are drilled part way through the extended bottom of the bookcase as shown in the sectional view, Fig. 4. The basket is removed from the desk by simply tilting it forward about halfway, then raising it slightly and pulling out the bottom until the screwheads clear. Construction of the drawers is pretty well covered in Fig. 3. Note that the drawer fronts are of striated plywood and that the sides are fitted into rabbets cut in the ends of the frontpieces. The ends of the drawer sides are cut at an angle of 10 deg. Assemble with screws and glue and then sand all corners slightly rounded.

The type of finish applied depends on the kind of wood used. Fir plywood is the most inexpensive and is easily available, but oak, birch or maple-faced plywoods make

the best job. Fir plywood can be given an attractive finish by first applying a white filler and immediately wiping the coating so the prominent grain of the wood shows through. Allow the filler to dry, sand lightly and follow with a sealer. Sand this when dry and finish with clear varnish or water-white lacquer. Maple or birch can be given the same treatment with good results. Oak can be finished in the same way, but will require careful sanding of the filler in order to high-light the grain. If a painted finish is desired, use fir plywood and apply the filler first. Sand lightly when dry and apply an enamel undercoater. Follow this with one or two coats of enamel in the color desired. Of course, only the flat surfaces can be sanded. Parts made from striated plywood are smoothed with steel wool.

DESK ON FILE CABINET

File Cabinet Forms Pedestal Base for a Desk



A two-drawer file cabinet of either wood or metal serves as the pedestal for this student desk. Holes are drilled through both sides of the file cabinet near the top. The holes are for tie rods to hold wooden rails to which the balance of the parts can be attached with screws and nails. The two legs are tapered from 2 in. to 1 1/2 in. sq. at the lower ends and are joined to rails at the side and back with mortise-and-

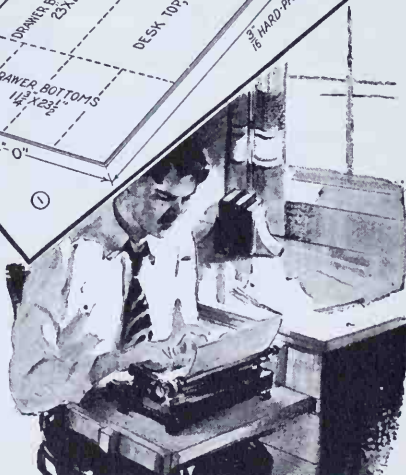
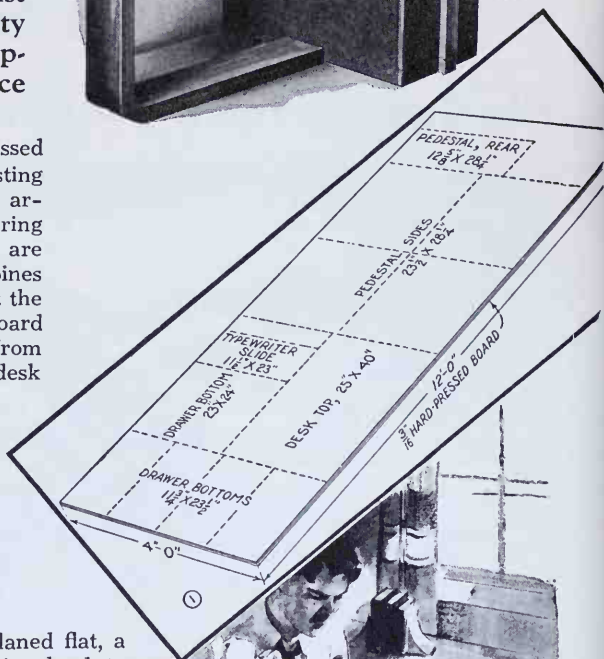
tenon joints. Attach the inner end of the back rail and the plywood bottom of the drawer compartment to the wooden strip on the file cabinet. The top is cut from 3/4-in. walnut plywood. The center drawer can be made in the usual way with the bottom fitted into grooves cut in the sides and front. The plywood bottom is nailed to the bottom edges of the sides and back. Stain or paint the wooden parts.

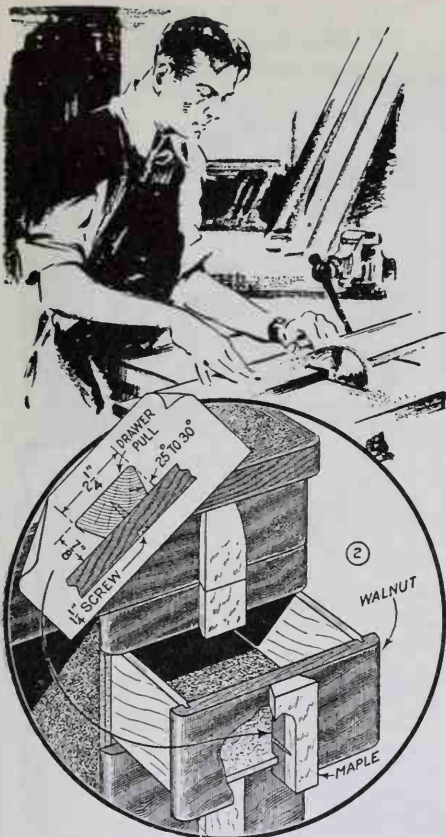
DESK FOR MODERNS

has
pleasing
lines

A typewriter slide at just the right height and plenty of drawer space for supplies and correspondence

BUILT of walnut and hard-pressed board, this desk has contrasting maple drawer pulls, which are arranged in line vertically, appearing as one piece when the drawers are closed. A curved member combines as a leg and stretcher to support the overhanging top. Hard-pressed board "veneered" over a core built up from soft wood makes an excellent desk top, is ideal for the drawer bottoms, and, in double thickness, is used for the panels of the pedestal as well. Fig. 1 shows how the pieces are cut from a standard 4 by 12-ft. piece of hard-pressed board, $\frac{3}{16}$ in. thick. The core for the top is built up from $1\frac{1}{8}$ -in. pine, edge-glued and fitted with reinforcing end cleats as in Fig. 4. After the top is planed flat, a sheet of $\frac{3}{16}$ -in. pressed board is glued to the upper side. If a press large enough is not at hand the work may be weighted until the glue has set. Casein glue is the thing for this job, as it is more easily handled than the hot cabinet glue. When dry, the lower side of the top should be grooved on the circular saw to a depth of $\frac{1}{2}$ in., the grooves being spaced 3 in. apart. This will minimize





any tendency to warp. The edges are squared and $\frac{5}{8}$ -in. walnut strips are glued to the ends and the front and back. Then the edges are sanded flush and the corners are rounded as in Fig. 4.

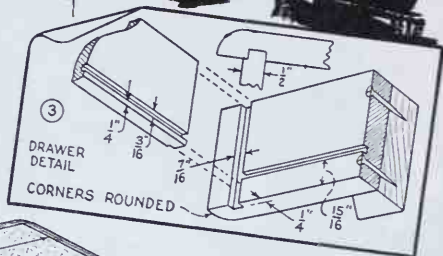
Drawers slide on $\frac{3}{4}$ -in. plywood shelves supported by two panels of $\frac{3}{16}$ -in. pressed board, placed with the smooth side in, and screwed to the shelves. A second pair of sides are added with the smooth side out and are held by a line of screws at the edges. In this way the screws supporting the shelves are hidden. After squaring the side panels, lines are scribed to locate the upper edges of the shelves. Holes for the screws are countersunk so the screwheads will be flush. Details in Fig. 4 show the rear corner construction. An apron screwed to the top incloses the sides and back of the wide drawer, which may be supported either by cleats or by a dustproof panel.

Pieces of walnut from which the leg is assembled, as in the detail in Fig. 4, are joined with glue. Notice particularly that the tongue on the horizontal piece is cut off-center, so that the outer corner can be rounded after assembly without weakening the joint. A fillet for the inside corner can be cut by boring a $\frac{1}{2}$ -in. hole in a walnut plank, edgewise, and then sawing out a piece with a right angle, the sides tangent to the hole. The fillet is glued in place and cut to the outside curve. If you have a shaper it's an easy matter to make a suitable fillet. Corners at the top also can be filled with pieces similarly made.

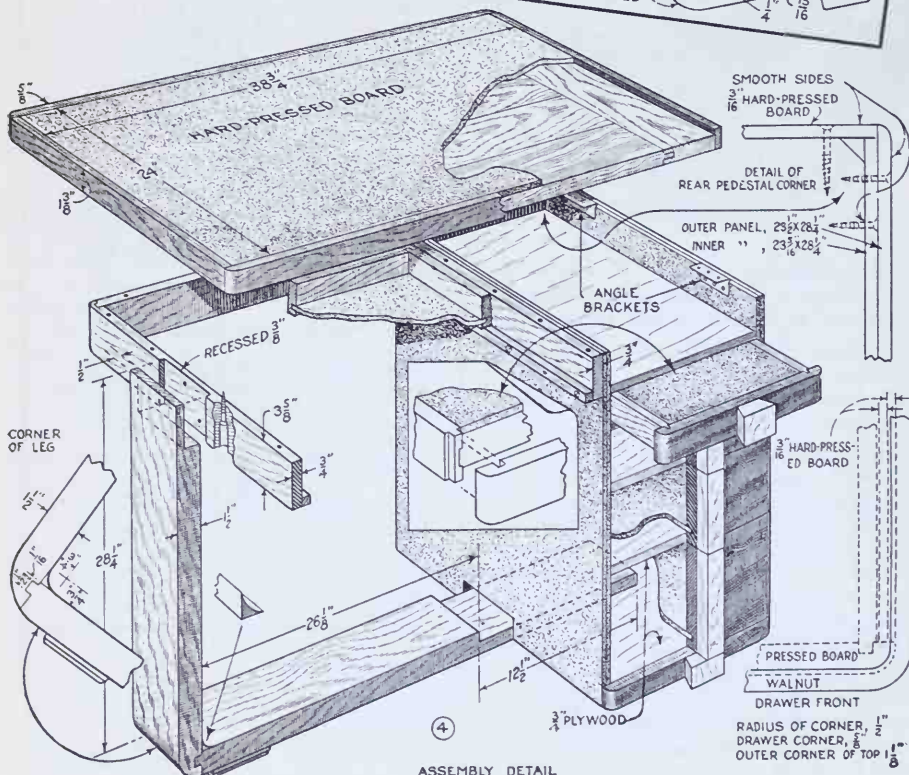
The drawer sides have a shoulder cut

Material List

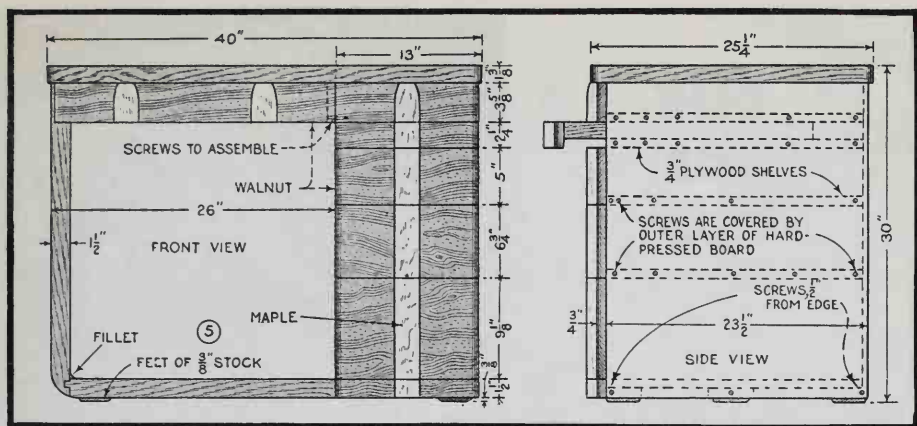
Edge of top	
2 pcs. walnut	11/16 by 1 1/2 by 40 in.
2 pcs. "	11/16 by 1 1/2 by 24 in.
Edge of shelf	
2 pcs. walnut	11/16 by 1 1/2 by 24 in.
Drawer fronts	
1 pc. walnut	3/4 by 3 3/8 by 40 in.
1 pc. "	3/4 by 2 1/4 by 13 in.
1 pc. "	3/4 by 5 by 13 in.
1 pc. "	3/4 by 6 3/4 by 13 in.
1 pc. "	3/4 by 9 1/2 by 13 in.
1 pc. "	3/4 by 1 1/2 by 13 in.
Leg	
1 pc. walnut	1 1/2 by 5 by 29 in.
1 pc. "	1 1/2 by 5 by 38 in.
Apron	
1 pc. walnut	3/4 by 3 3/8 by 24 in.
1 pc. "	3/4 by 3 3/8 by 26 in.
1 pc. hardwood	3/4 by 3 3/8 by 24 in.
Cleats for drawer	
2 pcs. hardwood	11/16 by 11/16 by 24 in.
Bottom cleats	
2 pcs. hardwood	3/4 by 4 by 12 1/2 in.
Feet	
3 pcs. hardwood	3/8 by 3 by 4 in.
Drawer sides	
4 pcs. hardwood	1/2 by 3 by 24 in.
2 pcs. "	1/2 by 4 3/8 by 24 in.
2 pcs. "	1/2 by 6 1/8 by 24 in.
2 pcs. "	1/2 by 8 1/2 by 24 in.
Drawer rear ends	
1 pc. hardwood	1/2 by 2 1/2 by 24 in.
1 pc. "	1/2 by 2 1/2 by 11 3/4 in.
1 pc. "	1/2 by 4 by 11 3/4 in.
1 pc. "	1/2 by 5 5/8 by 11 3/4 in.
1 pc. "	1/2 by 8 by 11 3/4 in.
Drawer pulls	
1 pc. maple	7/8 by 2 1/4 by 37 in.
Shelves	
5 plywood or built-up panels	11/16 by 12 1/4 by 23 5/16 in.
Core	
1 pine (built-up) top	1 1/8 by 24 by 39 in.
Shelf	
1 pc. pine	1 1/8 by 12 by 24 in.
1 sheet tempered hard-pressed board	3/16 in. by 4 ft. by 12 ft.



A sliding shelf for a typewriter is built up in the same way as the top. It must be fitted closely and the front piece is not glued on until the drawer pull is attached.



ASSEMBLY DETAIL



After the parts of the drawers are glued and fitted, the fronts are cut to length and the corners rounded to a $\frac{5}{8}$ -in. radius. The adjoining ends of the upper drawers may be left square if desired. Then the fronts are sanded and a line is scribed down the center to locate the screw holes for the pulls. These are made in one piece. Fig. 2 shows a sectional and side view of a pull on the upper drawer. A center line is scribed down the back, the edges are beveled, and the front corners rounded. Registering holes are then drilled through the fronts and the strip from which the pulls are to be cut. Finally, the strip is screwed to one drawer at a time and sawed off. This is done with the drawers in order to assure the grain in the pulls will match. Holes in the drawer fronts are drilled a size larger than the body of the screw so that after the pulls are screwed in place, they may be tapped with a mallet to align the strip perfectly. Note that the upper pulls are curved in from a point $1\frac{1}{4}$ in. from the top end to meet the edge of the desk top.

Screws fasten the apron to the leg and left side of the pedestal. The right side of the pedestal is held to the top by brass angles recessed to clear the drawers as in Fig. 4. Three feet, of $\frac{3}{8}$ -in. material, are attached as shown in Fig. 5. This brings

the over-all height to just 30 in. All exposed edges are rounded slightly and sanded smooth. Walnut parts of the desk are given two coats of boiled linseed oil to darken the wood. When this is dry it is followed with several coats of wax, each coat thoroughly polished. The pressed board is simply waxed, without an undercoat, but the maple drawer pulls require a coat of clear lacquer before waxing.

As you will see from the details, considerable variation of the materials used in this design is possible. For example, you can do the whole job in plywood, combining light and dark woods and finishing them in the natural colors. In this construction, the shelves on which the drawers slide would be glued in dadoes cut in the sides of the pedestal. The general appearance may be changed also to suit the surroundings by using the new modern drawer pulls in polished metal.

Repairs for Desk Drawers

If the joints of a drawer have become loose, it will be difficult to open and close it. In such a case, the remedy is to renail and glue the drawer so that it will slide easily. If swelling or warping is the cause of the trouble, the high spots should be sanded and waxed. It may be necessary to plane high spots lightly before the drawer will work smoothly.

REEDED STRIP

ANGLE BRACKET

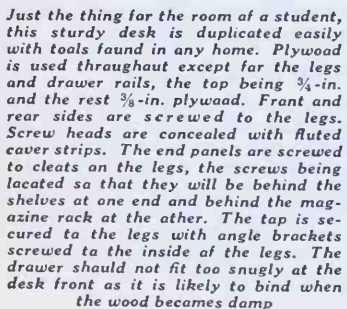
HARDWOOD CLEAT

BACK PANEL

LEG, $1\frac{5}{8}" \times 1\frac{3}{8}"$

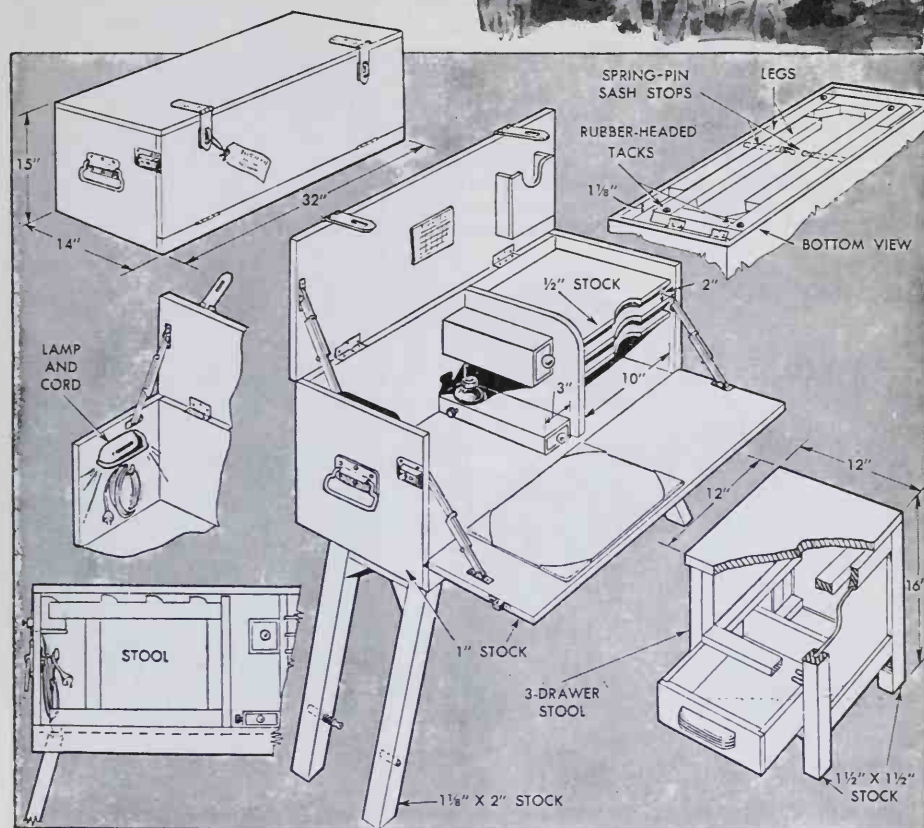
$\frac{3}{4}" \times \frac{3}{4}"$

CORNER



DESK FOR OUTDOORS

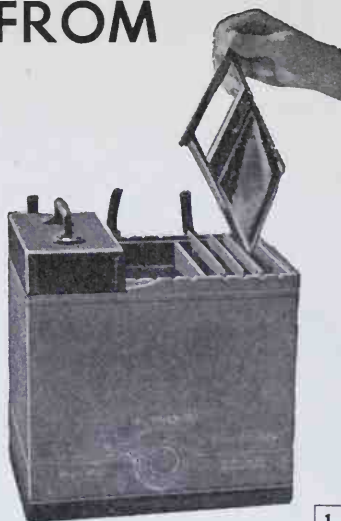
IDEAL for the naturalist, archaeologist or anyone who must do documentary work in the field, this folding desk-and-stool combination provides substantial writing surface along with comparative comfort. The desk folds into a compact case for traveling. In addition to containing all the essential writing equipment, it also carries the three-drawer stool. Shelves, together with the stool drawers, afford ample space for storing paper, records and reference books. Two small drawers at the center partition hold pencils, pens, etc. A bottle of ink is inserted in a hole cut in the lower drawer and is held by means of a thumbscrew. A lamp, which can be connected to a portable power supply, is attached as shown. In this location, the lamp will furnish sufficient illumination and still not interfere with packing of the stool. The desk legs fold for carrying and are held folded by spring sash stops. The desk legs fold for carrying and are held folded by spring sash stops.



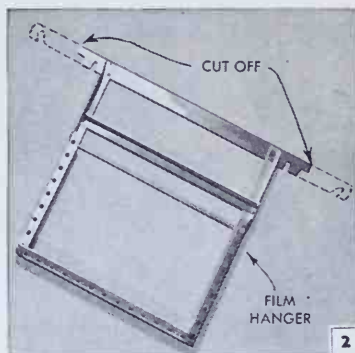
DEVELOPING TANK FROM BATTERY CASE

Here's a small three-in-one tank that's ideal for developing, rinsing and fixing cut film

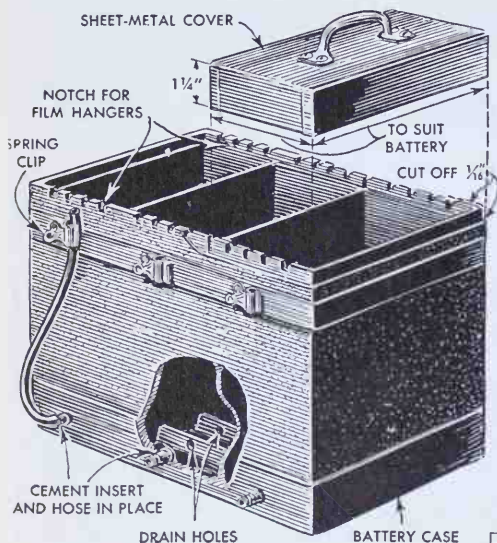
FOR the photographer who has occasion to develop small batches of cut film up to 5 by 7 in. in size, this compact unit, Fig. 1, will do the entire job; it requires little storage space and is easy to drain, Fig. 3. The tank proper is made from a 3-cell storage-battery case of 15 or 17-plate size, sound and free from cracks. After thoroughly cleansing the case with a soda and water solution, cut a shoulder around the outside top edges of one end cell to permit a light-tight fit for the cover, Fig. 4. Remove about $\frac{1}{16}$ in. Then cut notches in the top of each cell for the number of film holders you will require and make a slit for the lip of the cover that fits against the compartment dividing the center and end cell. The cover is dimensioned to fit, making sure that it will not leak light. Finish it with several coats of acid-resisting paint. Holes are drilled in each cell and through the bottom ribs to insure complete drainage. Force rubber inserts into each outside hole and attach lengths of rubber tubing to these, holding the tubing in place with clips screwed to the side of the case. Finally, it will be necessary to shorten the arms of the film holders to fit the tank, Fig. 2. In use, the cell with the lid is for the developer; the center cell is for the rinse and the uncovered end cell for the fixing solution.



1



2



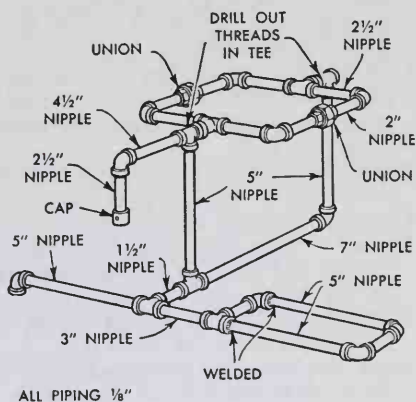
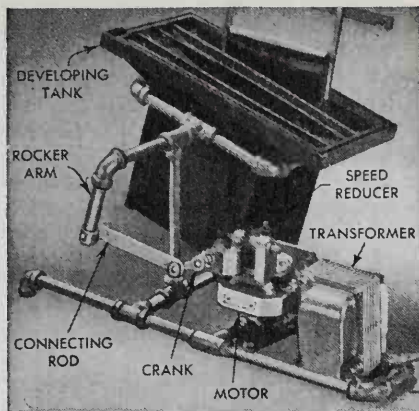
4



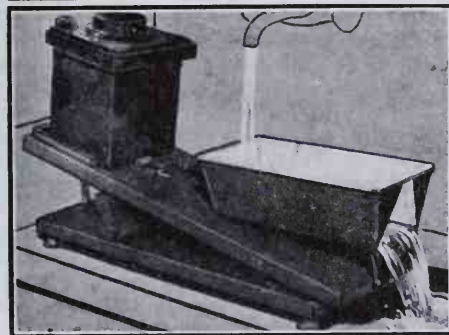
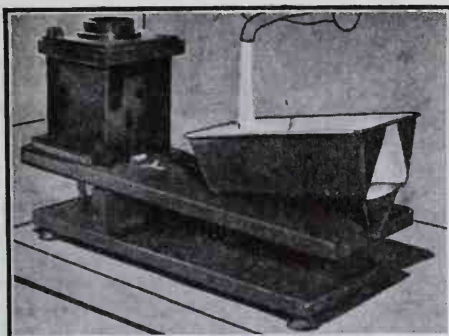
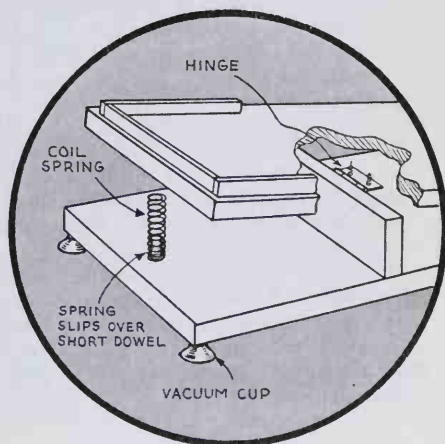
3

DEVELOPING TANK AGITATOR

Made entirely from standard pipe nipples and fittings, this film-tank agitator is operated by a speed reducer coupled to a small 6-volt electric motor and transformer. The speed reducer (60 r.p.m.) and motor, which are available at electrical stores, actuate the film-tank cradle by a flat-iron connecting rod. Although designed for a standard cut-film tank, the unit also will accommodate a roll-film tank if a circular opening is cut in a piece of plywood for the tank which then is placed on top of the cradle. Reamed pipe tees form bearings or pivot points for the shafts of the cradle, the latter being assembled in one piece by means of two unions. The shaft to which the rocker arm is fastened is attached after the cradle is in position. Note that the base of the agitator requires soldering or welding two of the connections; otherwise all pipe parts merely are threaded into one another. The transformer and motor are anchored to the frame with machine screws.



empty. The pan is open at one end and is mounted with the open end high. A spring under the tank causes a rebound as the rocker comes down, increasing agitation.



Water running from a faucet operates this agitator, which rocks as a pan fills and dumps itself automatically. The rocker is hinged to a base so that the weight of the tank overbalances that of the pan when

Anneal: To soften metal by heating it to a critical temperature and allowing it to cool very slowly.

Bore: To enlarge a hole with a boring tool in a lathe or boring mill.

Boss: An integral part projecting from a casting or forging.

Braze: To join parts by use of hard solders.

Broach: To finish the inside of a hole, generally to a shape other than round. A tool used for this purpose.

Buff: To polish with a cloth wheel loaded with fine abrasive or polishing rouge.

Burnish: To polish with a rolling or sliding tool which is kept under pressure.

Bushing: A bearing sleeve or liner which is removable.

Carburize: To prepare a low carbon steel for heat treating by packing with carbonized material and heating to approximately 2,000 degrees for several hours, then cooling slowly.

Case Harden: To harden the surface of carburized steel by heating it to a critical temperature and then quenching it in an oil or lead bath.

Castellate: To form metal into a castellated shape such as castellated nut, etc.

Chamfer: To bevel a sharp corner or edge.

Chase: A term describing the cutting of threads in a lathe, as distinguished from cutting with a die.

Chill: Hardening the surface of cast iron by chilling in a metal mold.

Color-Harden: Case hardening to shallow depth, done for mottled appearance.

Core: In foundry practice, to form the hollow part of a casting.

Counterbore: A cylindrical enlargement of the end of a cylinder bore. A tool with a piloted end used for this purpose.

Countersink: To drill or otherwise form a depression of a given depth to take the conical head of a screw flush with the surrounding surface. The tool used for this purpose.

Crown: An angular contour, higher at the center, as the face of a flat-belt pulley.

Die: (a) A formed and hardened metal block for shaping or impressing a design into sheet metal or cutting a shaped disk or other form from sheet metal.

(b) A tool for cutting external threads.

Die Casting: An accurate, smooth casting resulting from pressing or forcing a molten alloy under pressure into metal mold.

Die Stamping: The sheet metal object shaped or cut by a die.

A 'Dictionary'

Draw: (a) To elongate or form by a distorting operation or process.

(b) To temper steel by quenching at timed intervals.

Drill: To sink a hole into or through a piece of metal, usually with a twist drill.

Drop Forging: A piece of wrought metal formed hot to desired shape with dies, either by pressure or under a forging or drop hammer.

Face: To true a flat surface in a lathe, the surface being perpendicular to the axis of rotation.

File: To remove metal from the surface with a file.

Fillet: A rounded filling of the corner formed by two parts meeting or joined at an angle.

Fin: A thin rib projecting from the main body, as on an air-cooled cylinder.

Fit: The contact, or perhaps more properly, the interference between two machined surfaces and generally described as "drive," "force," or "press" fit,— "shrink," where heat is used to expand one of the parts,— "running" or "sliding," where free movement of a shaft must be allowed, and "wringing," where interference of the shaft is greater than the running or sliding fit and one part must be twisted, by hand, into the other.

Flange: A projecting rim for stiffening, fastening, or limiting movement.

Forge: To shape hot metal, either by hammering or by a pressure process.

Graduate: To indicate a division of a scale or instrument dial or other measuring device into regular or uniform spaces.

Grinding: The process of finishing a surface with a grinding wheel or disk.

Key: A small piece of metal inserted in an opening which is generally cut half in the shaft and half in the hub of a wheel or gear to prevent movement of the parts one over the other.

Keyway: A groove or slot cut to take a key of given size.

Knurling: The process of uniformly indenting a turned part or surface to give a surer hand or finger grip.

Lap: A piece of metal, wood, leather, or rubber charged with fine abrasive and used for the purpose of imparting an accurate finish. To finish by lapping.

of Shop Terms

Lug: A projecting part of a casting or forging generally rectangular in section or shape, differing in this respect from a boss.

Malleable Casting: A small casting to which a degree of toughness is imparted by a process of annealing.

Mill: To machine true surfaces, grooves, and the like with a rotating cutter.

Pack Hardening: A process which, in a sense, combines the two processes of carburizing and case hardening.

Pad: A shallow projection usually formed on a casting for the purpose of mounting some separate part to be attached with bolts or screws. Differs from a boss in shape and size.

Peen: The act of stretching or distorting metal by strokes of a ball-peen hammer. Applies to hand riveting and art metal work.

Pickling: A process of cleaning castings in hot bath of weak sulphuric acid solution.

Plane: To finish work on a planer, a machine having a fixed cutting tool and moving table or bed.

Planishing: A process of finishing sheet metal by hammering with hammers having polished faces.

Polishing: A frictional process with a fine abrasive or rouge to impart a lustrous finish.

Profiling: Machining an outline or contour with a rotary cutter, the movement of which is controlled by a master die or shape exactly the same of that of the outline.

Punch: Usually applies to perforating sheet metal of varying thicknesses with a non-rotating tool.

Ream: To bring a drilled hole to accurate diameter with a rotating fluted tool.

Relief: Variations in the plane surfaces of two or more parts in an assembly or in the machined or formed surfaces of a single piece. Briefly, one plane surface above or below another.

Riveting: Peening or upsetting the protruding end of a rivet or pin which is used to fasten two or more parts permanently together.

Sandblasting: To clean rough castings or forgings with sharp sand driven through a nozzle by compressed air.

Shape: To shape metal on a shaper, the latter a machine tool differing from the planer in that the tool moves and the work is held stationary.

Shear: To cut sheet metal or brass in a machine having two blades.

Shim: A spacer of thin sheet metal used for adjusting clearances in bearings, blocking an object at proper height, position, etc.

Spin: To shape a piece of rotating sheet metal in a lathe by forcing it, with special tools, to take shape against a form.

Spline: A long keyway or series of keyways cut about the circumference of a shaft,—as a splined end.

Spot Face: To finish a circular spot on a rough or irregular surface with an end milling cutter for the purpose of seating a capscREW or bolt head.

Spot Weld: To weld in a series of spots by heat resistance to electric current, applicable to all except sheet copper and brass.

Steel Casting: Ordinary cast iron alloyed with varying amounts of scrap steel.

Swage: To shape metal by hammering or by pressure over a swage block.

Sweat: To join metal by sweat soldering wherein two pieces are clamped together with solder between and heat applied until the solder melts and flows.

Tack Weld: To join parts by a series of short welds.

Tap: To cut threads in a drilled hole with a tap.

Temper: To change the physical characteristics of steel by heat treating.

Template: A pattern for laying out or transferring shapes, the location of a series of holes, etc.

Tolerance: The total of the acceptable variations in the size of a machined part.

Tumble: To clean and smooth rough castings, forgings, or other parts by placing them in a rotating drum and adding such mediums as metal scraps, hardened balls, etc.

Turn: To machine work in a lathe, commonly taken to mean parts mounted between centers. Differs from facing.

Upset: To forge, by means of hammering or pressure, a section of larger diameter on a bar.

Welding: Primarily taken to mean the joining of two pieces by heating to the fusing point and pressing or hammering together.

RAWHIDE STRIP CARRIED ACROSS RUNGS TWICE

BACK HAS 2" RAKE

1 1/2" STRIP

STAPLED

BASKET WEAVE

5/8" TENONS

2" X 2" CORNERS ROUNDED

1 1/2" TAPERED TO 1"

18"

16"

48"

17 1/4"

9"

12"

18"

16"

17"

4"

2"

4"

8"

6"

1 1/8"

1 1/2"

4 1/2"

10"

HERE is an extension table and set of chairs especially designed for those who have a small dining room and would like furniture of a rather rustic type. Construction of these pieces is relatively simple and the whole set can be made with a few hand tools. Both ends of the table slide out so extra leaves can be added. Almost any kind of wood can be used, even white pine, although hardwood is more durable and provides greater rigidity.

The table legs are cut from square stock and tapered slightly toward the top. While lag screws are used for securing them to the leg crossrails, both end stretchers are mortised, glued, and dowel-pinned. Before fastening the top permanently, the upper edges of all boards are chamfered to form V-grooves when assembled. Both extension ends are mounted on slides that permit the ends to be pulled out so that room is provided for two 10-in. leaves. Dowel stops near the end of each slide prevent the extension ends from being pulled clear out.

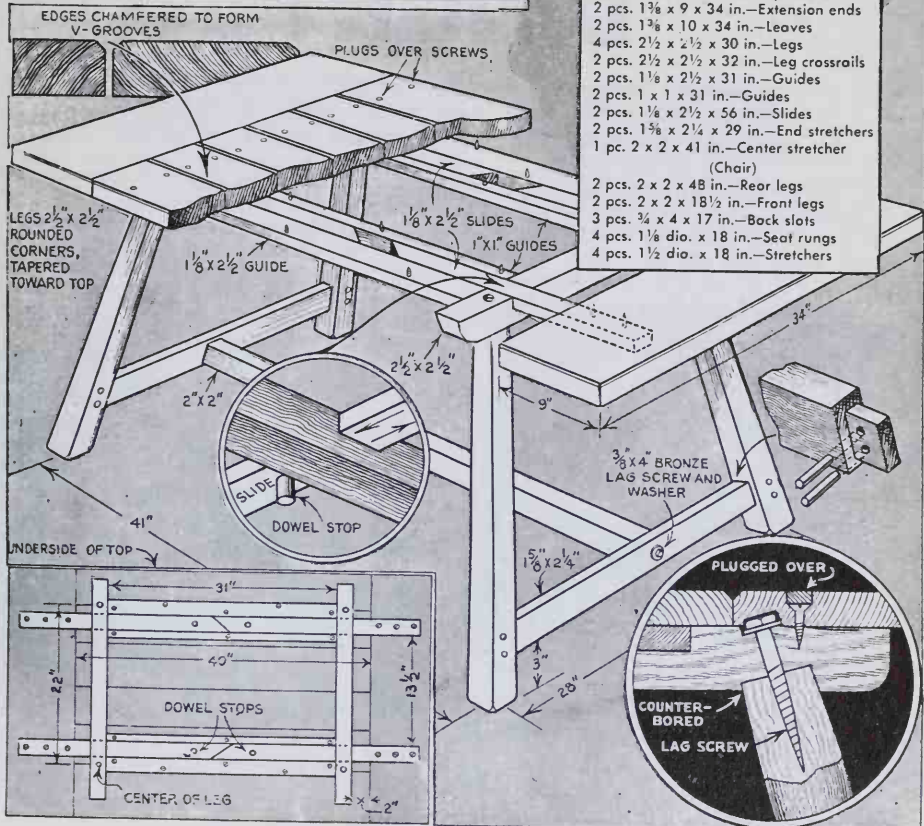
Like the table legs, all chair legs are cut from square stock after which the corners are rounded. If a lathe is available, tops of the chair-back uprights can be turned as indicated, or they may be tapered slightly and finished off square. Also, the rungs may be shaped from square stock, using hand tools to round the corners and taper the ends, which are forced into holes bored in the legs. Strips of 1/2-in. rawhide that make up the seats in basketweave pattern, are stapled on the inside of the seat rails, each strip being carried across the top of the rails twice.

Finishing the set is a matter of preference, but if an open-grained wood has been used, such as mahogany, walnut or oak, the pores must be filled with a prepared paste filler of the proper color. After the filler has been wiped off and has hardened, the work is sanded lightly and dusted, after which shellac and wax or several coats of high-grade varnish are applied, if a natural finish is desired.



(Table)

- 2 pcs. 1½ x 7 x 40 in.—Top center
4 pcs. 1½ x 5 x 40 in.—Top center
2 pcs. 1½ x 9 x 34 in.—Extension ends
2 pcs. 1½ x 10 x 34 in.—Leaves
2 pcs. 2½ x 1½ x 30 in.—Legs
2 pcs. 2½ x 2½ x 32 in.—Leg crossrails
2 pcs. 1½ x 2½ x 31 in.—Guides
2 pcs. 1 x 1 x 31 in.—Guides
2 pcs. 1½ x 2½ x 56 in.—Slides
2 pcs. 1½ x 2¼ x 29 in.—End stretchers
1 pc. 2 x 2 x 41 in.—Center stretcher
(Chair)
2 pcs. 2 x 2 x 48 in.—Rear legs
2 pcs. 2 x 2 x 18½ in.—Front legs
3 pcs. ¾ x 4 x 17 in.—Back slots
4 pcs. 1½ dio. x 18 in.—Seat rungs
2 pcs. 1½ dio. x 18 in.—Stretchers





DINGHY

Lightweight, plywood construction and easy portability make this trim, seaworthy boat ideal for the hunter or fisherman who desires a boat that can be carried on top of his car

ANYONE—even the most inexperienced craftsman—can build this lightweight dinghy at small cost. It takes relatively little storage space and can be loaded on a car singlehanded. If you are not interested in a boat for hunting or fishing, but like to take your family on week-end trips to a lake or river, this boat will add to your pleas-

ure. Just load the family in the car, put the boat on top and take off.

It rides high and level in the water, making it safe for the children to handle, and easy to row or scull in shallow backwaters for fishing or wildfowl hunting. A 25-in. skeg holds the craft steady if you wish to power it with an outboard motor.

The boat is assembled almost completely on a building board. Two full frames, three half frames, and the stem and transom join chines and clamps, or sheer battens, to provide adequate support for the 1/4-in. plywood bottom and sides.

To start construction, first set up the building board on a level surface, such as the garage floor, and cut the five notches for the frames. Then make all the frames and attach them to the building board in the order indicated in the detail on the opposite page. Note that the full frames are reinforced with plywood knees, or gussets, attached with screws and waterproof glue. After the frames are in place on the building board, brace them to



MATERIAL LIST **Marine Fir Plywood**

1 pc.	Bottom	1 1/4" x 4' - 0" x 8' - 0"
1 pc.	Sides	1 1/4" x 4' - 0" x 8' - 0"
1 pc.	Transom and stem	1 1/4" x 2' - 0" x 6' - 0"
Oak		
2 pc.	Chines	3/4" x 1 3/4" x 8' - 0"
2 pc.	Clamps	1 1/2" x 1 1/2" x 8' - 0"
2 pc.	Moldings	5/8" x 1 1/4" x 8' - 0"
2 pc.	Seat risers	3/4" x 1 1/2" x 8' - 0"
1 pc.	Keelson	3/4" x 2 3/4" x 8' - 0"
1 pc.	Keel	3/4" x 3/4" x 8' - 0"
1 pc.	Top and bottom of transom and stem frame	3/4" x 5 3/4" x 12' - 0"
1 pc.	Transom and stem sides and frame side ribs	3/4" x 3" x 12' - 0"
2 pc.	Bottom ribs	3/4" x 4 3/4" x 9' - 0"
2 pc.	Seats	3/4" x 12" x 14" - 0"
1 pc.	Seat brace	3/4" x 12" x 8"
4 pc.	Knees	1 1/4" x 7" x 10"
1 pc.	Motor board	3/4" x 12" x 21"
9 pc.	Floor boards	1 1/2" x 2 3/4" x 4' - 6"

Building Board

- 1 pc. 2" x 10" x 7' Common lumber
- 1 pc. 1 3/4" x 1 3/4" x 4' Lumber

Fastenings

- 1 qt. Marine glue
- 20 yds. Cotton tape
- 5 gr. 1" - #8 brass flat-head screws
- 2 doz. 1 1/2" - #8 brass flat-head screws
- 2 doz. 1 3/4" - #8 brass flat-head screws

Paint

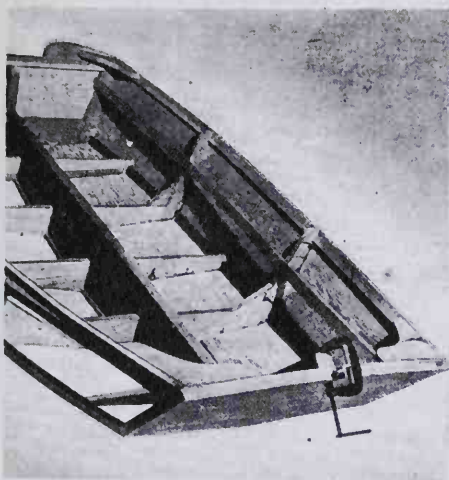
- 1/2 gal. Sealer (clear)
- 1 qt. Spar varnish
- 1/2 gal. Paint

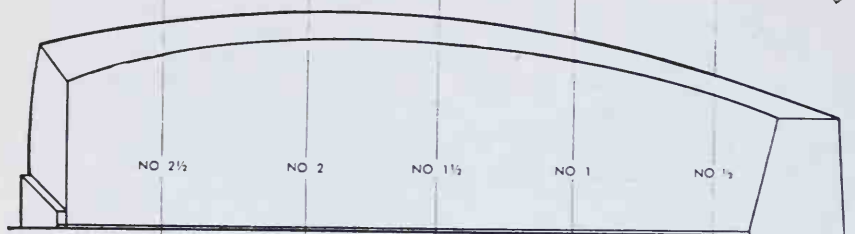
Fittings

- 1 pr. Oarlocks
- 2 Lifting handles
- 1 Eyebolt

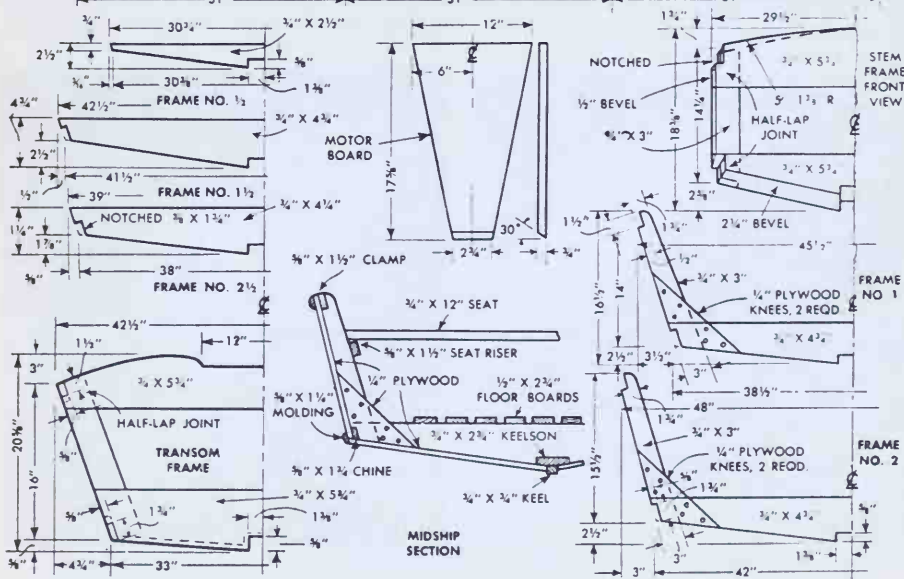
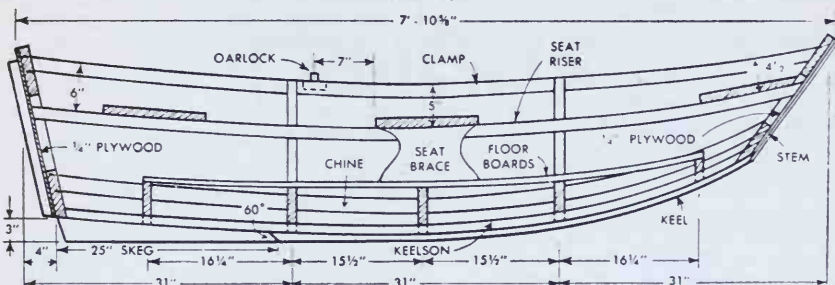
cially at frames Nos. 1/2, 1 and 2 1/2 and also at the stem and transom. In this case, it probably will be necessary to bevel the bottom of each notch to receive the chine and clamp with a full bearing across the width of the frame stock.

Next, the frame members and chines must be faired in—hand planed as in the photo at the left—to take the sides and bottom with a full-width bearing. This means that the outer edge of each chine and one edge of each frame member must be beveled slightly so that the plywood bottom pieces and the sides will lie flat on the chines and frame members. This is an important operation as the structural strength and seaworthiness of the boat depend on the fit of these joints. Be sure that the keelson is beveled in two directions before fitting the keel and skeg. Join the latter two parts to the keelson with screws and marine glue, wiping off the excess glue after the joint has been made. For added strength, drill a 5/16-in. hole through the skeg and keelson at a point just aft of frame No. 2 1/2 and fit a 5/16-in. galv. or bronze bolt. Due to the absence of a stopwater at this point, it is advisable to set the bolt in marine glue. It's regular practice on a boat of this type to use cotton tape in all joints where the plywood joins the frame. Spread a coating of marine glue, lay the tape over the glue, then apply a second coat of glue before joining the parts. Use this procedure when joining the plywood to the frame. Now, cover the stem and transom frames with 1/4-in. marine plywood, joining with screws, marine glue and tape in the manner described.





PLAN VIEW



Fair the exposed edges of the plywood into the curve of the bottom and sides. Cut, fit and join the side planking, using the same material and method of fastening. Fair the edges of the plywood to the angle of the frames. At this point the boat can be removed from the building board.

Cut the plywood bottom pieces to the rough size and bevel plane to a perfect fit at the keel and skeg. Then join with screws, marine glue and tape, applying the glue liberally where the bottom pieces join the keelson and butt against the keel and skeg. Drive the screws flush and in straight rows. Space all planking screws approximately 1½ in. apart. Plane the edges of the bottom pieces flush with the sides and finish the upper edges of the side planks flush with the clamps. Sand all joints and exposed edges smooth. Fit oak corner knees fore and aft as in the lower left-hand photo on the opposite page, and join to the end frames and clamps with long screws driven through from the outside. Use a water-resistant resin glue in these joints. Before

fitting the half-round molding at the chines and gunwales, apply a coat of fir-plywood sealer to all inner and outer plywood surfaces. Fill the exposed edges of the plywood with marine putty and sand lightly after the putty is dry. Then sand all surfaces lightly and round corners to prevent splintering of the wood. Use fine sandpaper for this job. Coat the frames and interior plywood surfaces with marine enamel or spar varnish as desired.

Install the floor boards and join to the frames with screws only. Do not use any glue in these joints. Then add the seat risers and seats and install the motor board. All these parts should be of selected oak and finished with a natural wood filler and two coats of spar varnish. Install the half-round molding at the chines and gunwales, spacing the screws about 3 in. apart. Apply a copper-base paint to the bottom, and finish the sides, stem and transom with two coats of marine enamel. Finally, install the fittings given in the material list.

DINING ROOM FURNITURE

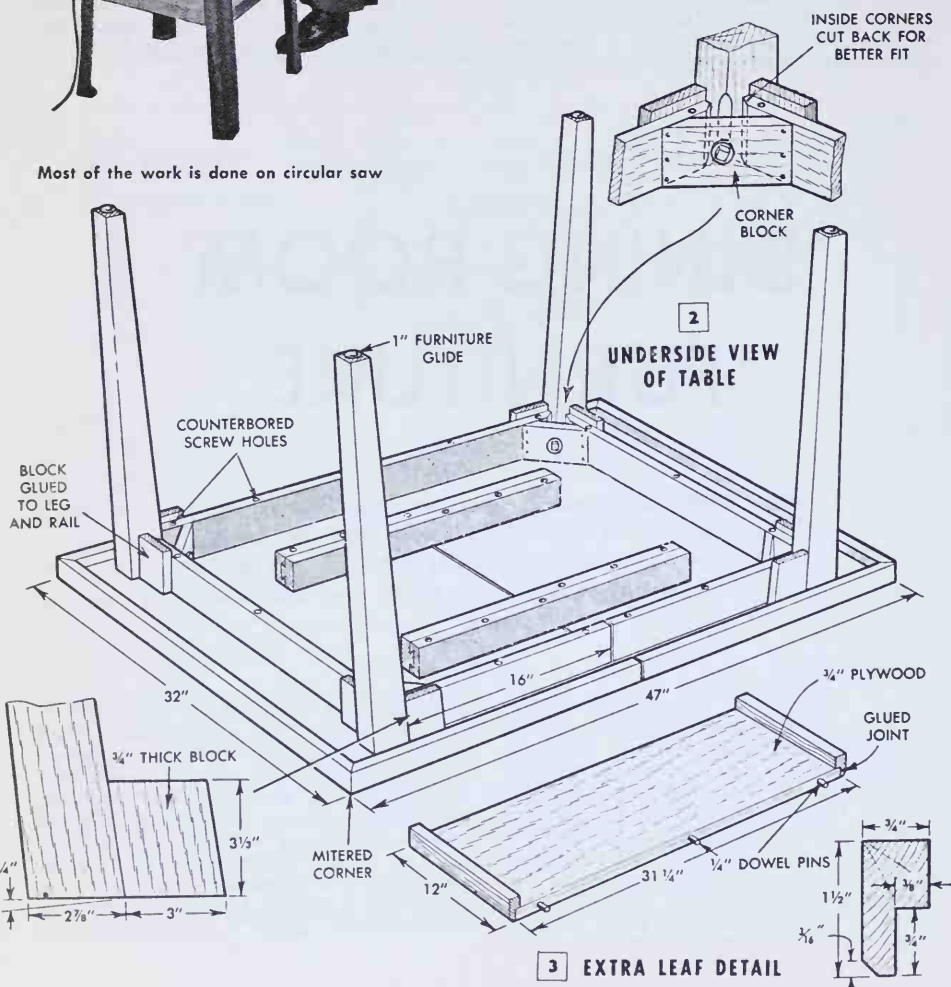
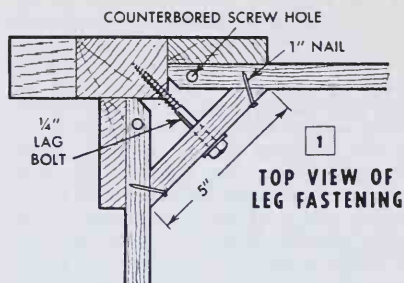
This smart-looking seven-piece dining-room group—one of a special series of fine furniture for the entire house—is our answer to the tremendous response received for more home-built furniture of good, practical design

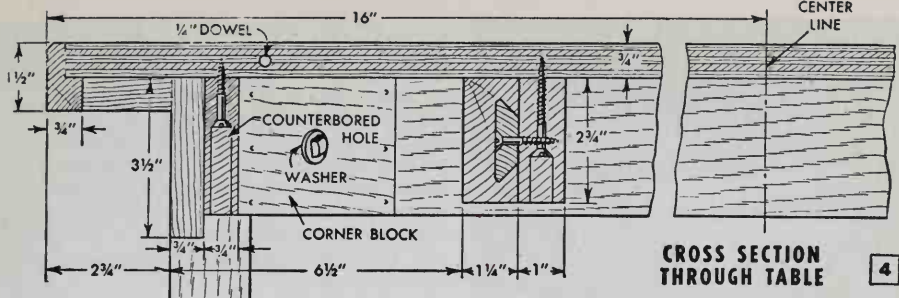
Designed expressly for the craftsman working with small home-workshop tools, this group features the same simplicity of line and ease of construction characteristic of the living-room and occasional furniture presented in previous sections of this book. The complete ensemble, which is sufficient to furnish a full-size dining room, consists of seven pieces, including an extension table for eight, four chairs, a credenza and a china cabinet. However, if you haven't room for the entire

group, you can eliminate the china cabinet or, in the case of an exceptionally small dinette or dining alcove, the base section of the two-piece china cabinet can be built and used alone as a server to take the place of the large credenza. The table is designed to take an extra leaf which permits serving as many as eight persons, and the seats of the upholstered chairs are spring-filled for real added comfort, a feature not found in all commercial suites.



Most of the work is done on circular saw





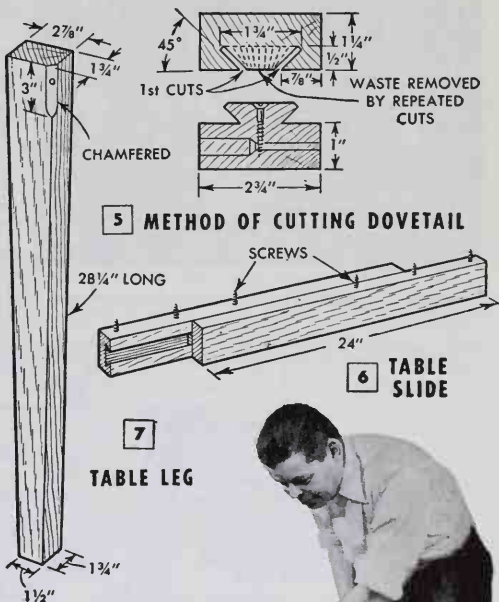
CROSS SECTION THROUGH TABLE

4

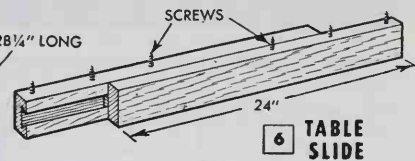
Construction of the table is detailed in Figs. 1 to 7 inclusive. Like the living-room suite, which incorporated the use of both plywood and solid stock, the table top and extra leaf are cut from $\frac{3}{4}$ -in. plywood to save the work of gluing up solid stock. All the rest of the table is made of solid material. A $\frac{3}{4} \times 1\frac{1}{2}$ -in. facing or edging strip, mitered at the corners and rabbeted on the back, is glued and nailed to the edge of the plywood to conceal the laminations. The top, of course, consists of two separate sections having the conventional aligning pins and holes in the edges at the joint. The sectional view in Fig. 4 indicates the position of the legs and the slides and also shows how the 3-in. aprons, or rails, are screwed to the underside of the top. The ends of the end aprons are cut off squarely, while the two-piece side ones, which butt together at the joint, are cut at an angle to match the slant of the tapered legs. Locate the side aprons $3\frac{1}{2}$ in. in from the edge of the top and the end ones 6 in. inward. Then glue and screw them securely to the plywood.

The tapered legs, Fig. 7, are cut from $1\frac{3}{4}$ -in. stock. Note in the detail at the left of Fig. 3, that the tops of the legs are cut at a $\frac{1}{4}$ -in. angle. Each leg is placed in the corner formed by the aprons and drawn up rigidly with lag screws. Corner blocks are drilled for the screws and then glued and nailed to the aprons as shown in Fig. 1. The lag screws are the only fastenings the legs require and, if the legs loosen with use, it is easy to make them rigid simply by drawing the lag screws tighter. Additional rigidity is had by the eight overlay blocks which are applied to the face of the aprons at the corners. Note that the blocks at the sides of the table are fitted flush with the face of the legs.

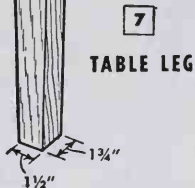
Figs. 4, 5 and 6 show how the dovetail joint is formed in the table slide. The



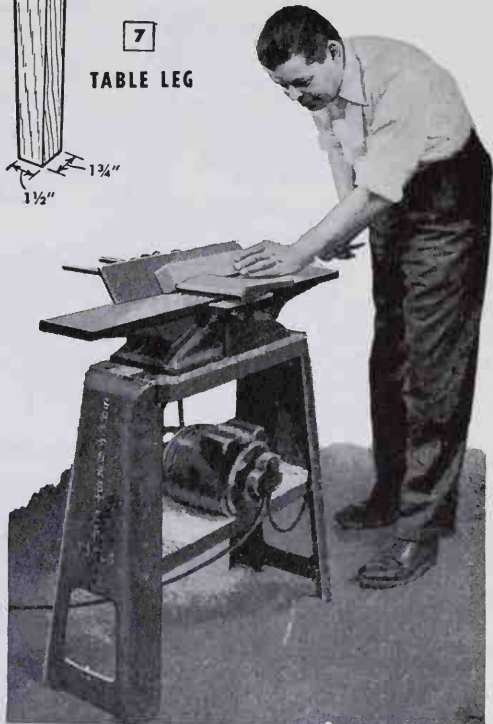
5 METHOD OF CUTTING DOVETAIL



6 TABLE SLIDE



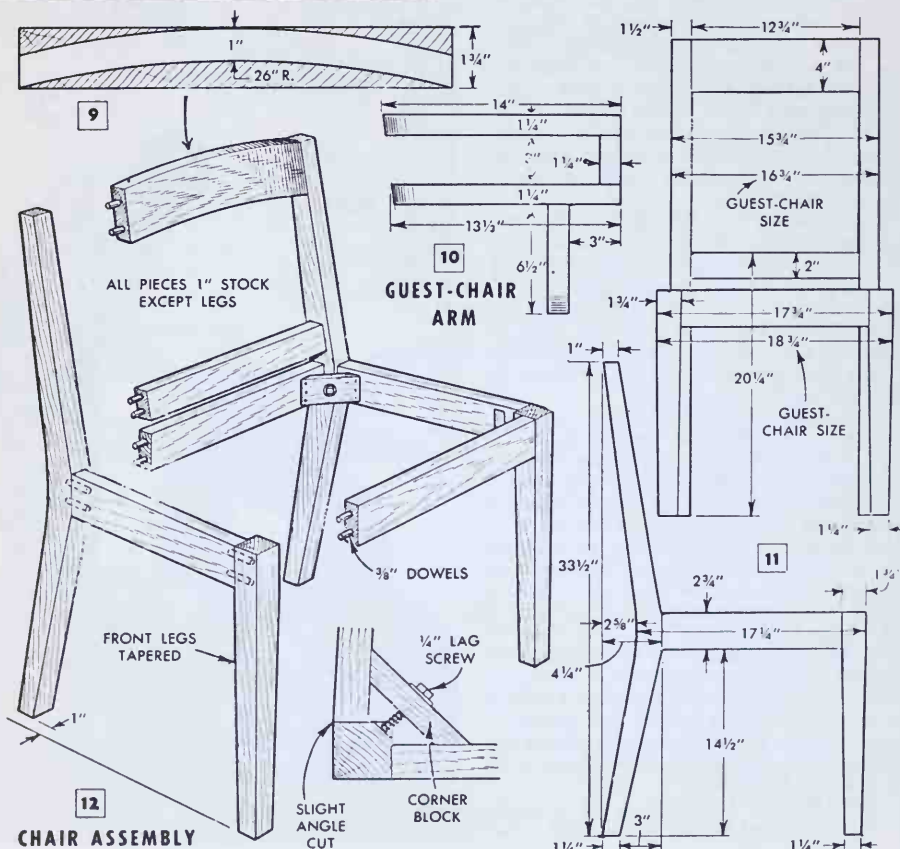
7 TABLE LEG

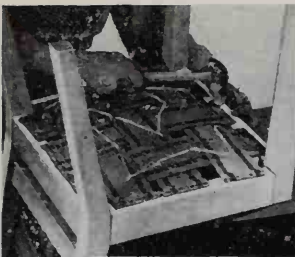




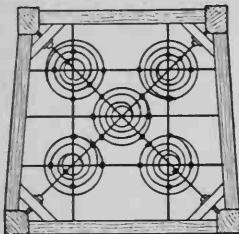
tenon on the male member of the slide consists of a separate strip shaped as shown and screwed to the face of the piece. This strip engages a matching groove in the female member. The groove can be cut on the circular saw by first making the two 45-deg. outside cuts and then removing the waste portion with repeated cuts, varying the angle of the blade slightly each time. The male members of the slide are glued and screwed to one half of the table and the female members to the other, using three screws in counterbored holes. A coating of wax will make the slides work smoothly.

Chair-frame construction is detailed in Figs. 9 to 12 inclusive. Whether four or more chairs are built, at least one should be made a guest, or host, chair by adding arms as shown in Fig. 8 and increasing the width of the front and back, Fig. 11. The over-all height and depth remain the same. Identical parts can be mass-produced to save time by using stops and jigs on the saw. As the legs are the only part of the





13 WEBBING ENDS DOUBLE-TACKED



14 SPRINGS CROSSTIED LIKE THIS



15 BURLAP IS TACKED OVER SPRINGS



16 THEN WELT IS TACKED TO EDGE

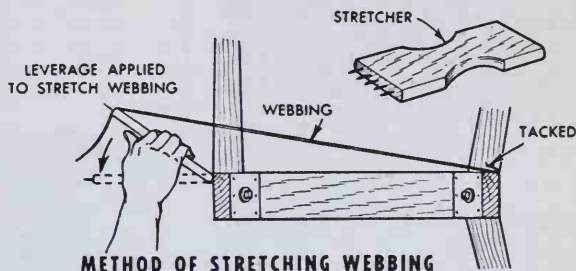


17 MOSS FILLING COMES NEXT

frame exposed, the rest of the assembly can be rough. Note in Fig. 12 that all members are doweled and each corner of the seat is braced with lag screws the same as the table. The curved back rail is handsawed from a piece $1\frac{3}{4} \times 4$ in., Fig. 9, while the front legs are tapered on all four faces from a point $2\frac{3}{4}$ in. from the top. The exposed part of the legs should be finished before upholstering.

Upholstering the chairs: The first step is to tack furniture webbing to the seat bottom, Fig. 13. Six strips are interlaced and stretched tautly in the manner indicated in the detail to the right of Fig. 16. The ends of the webbing are left about 1 in. long for folding back and double-tacking. Five No. 1 plain-end coil springs are used in the seat. These are placed in position, tack-sewed to the webbing, and then tied and cross-tied to the bottom of the seat rails as shown in Fig. 14. The dots in the drawing indicate knots. The springs are compressed so that the center one is about $1\frac{1}{2}$ in. above the top of the seat. The spring twine is brought down through holes punched in the webbing and tacked securely to the underside of the rails. Next, the springs are covered with burlap, Fig. 15. The edges are tacked, folded over and retacked, and then a welt edging is tacked around the outer edge on three sides, Fig. 16. The welt used here is the same as used later on the back, Fig. 25, except that being hidden it can be made up of scrap material wrapped around a length of $\frac{1}{4}$ -in. rope. Hair, tow or moss filling is added next, Fig. 17. This is held in place by tack-sewing it to the burlap. A layer of cotton is applied over the filling so it covers the sides of the seat rails, Fig. 18. After this, the whole job is covered with the finished fabric, and the completed seat should look like Fig. 19. Patterns for the seat covering as well as the rest of the chair are given in Fig. 24. When completed, the underside of the seat is covered with black cambric, the edges being folded under.

Two strips of webbing are tacked to the back, Fig. 20, and then it is covered with burlap, moss and finally cotton. The cotton is brought around the sides and over the top



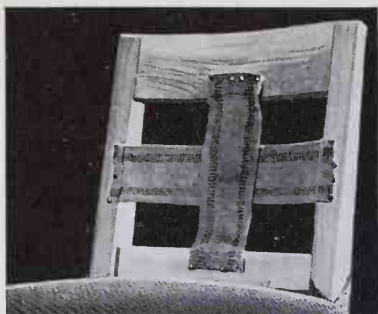
METHOD OF STRETCHING WEBBING



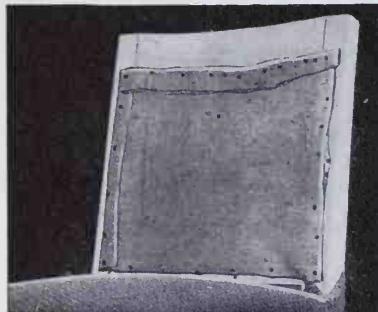
18 THEN IS COVERED WITH COTTON



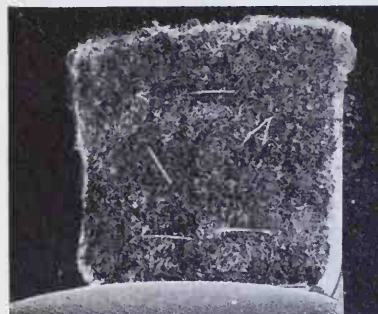
19 AND HERE'S THE COMPLETED SEAT



20 FIRST, WEBBING IS APPLIED TO THE BACK



21 THEN WEBBING IS COVERED WITH BURLAP



22 LAYER OF MOSS IS TACK-SEWED TO BURLAP

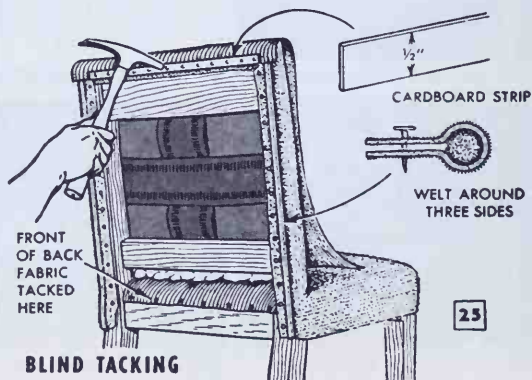
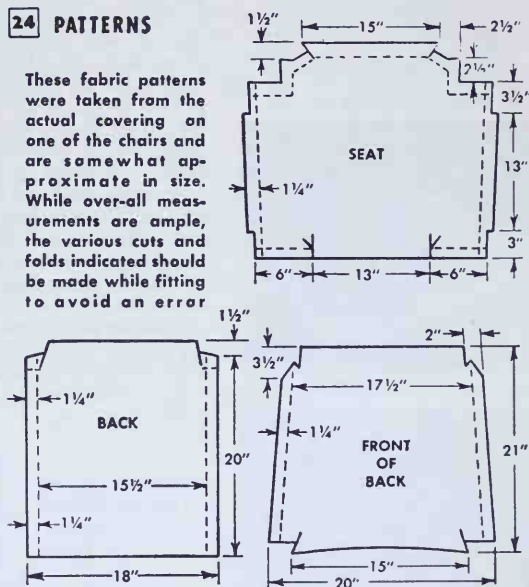


23 COTTON IS ADDED NEXT, THEN THE FABRIC

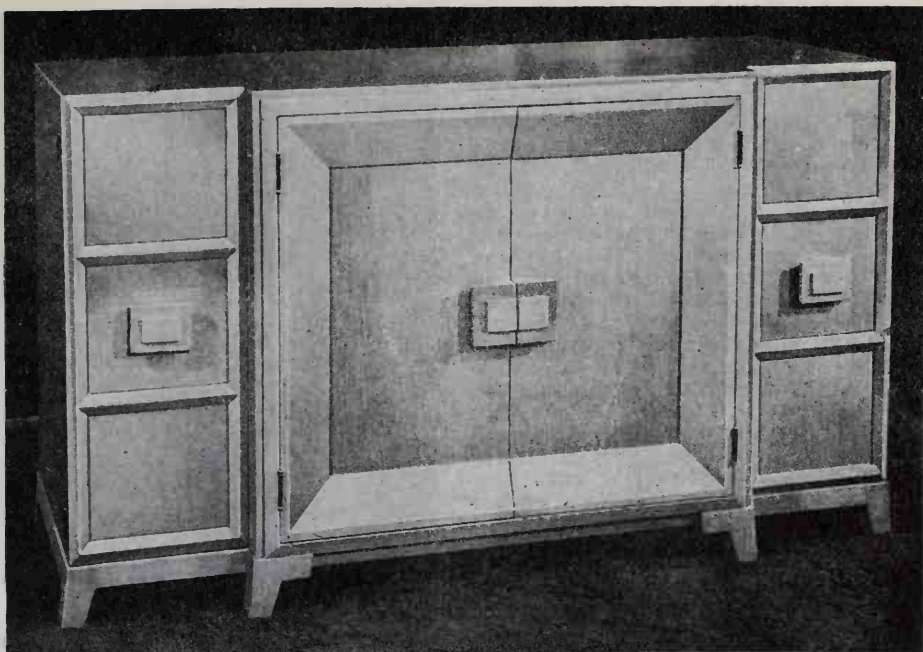
and the lower edge is folded up under the moss. Note in applying the covering to the front of the back that the fabric is first pulled through and tacked to the face of the rear seat rail, Fig. 25. Before the back covering is applied, a welt made of the finished fabric is tacked to three sides. Then a strip of cardboard, $\frac{1}{2}$ -in. wide, is cut to fit across the top between the welt at the sides. The fabric is tacked at the top first, driving the tacks through the cardboard strip as in Fig. 25. With the top tacked, the fabric is brought down over the back, the edges folded under and hand-stitched to the welt. Blued gimp nails are used in tacking the covering where it passes over the exposed surface of the legs. This method is called blind tacking. In addition to concealing the tacks, the cardboard strip provides a firm edge which avoids irregular pleats when the cloth is pulled taut.

24 PATTERNS

These fabric patterns were taken from the actual covering on one of the chairs and are somewhat approximate in size. While over-all measurements are ample, the various cuts and folds indicated should be made while fitting to avoid an error



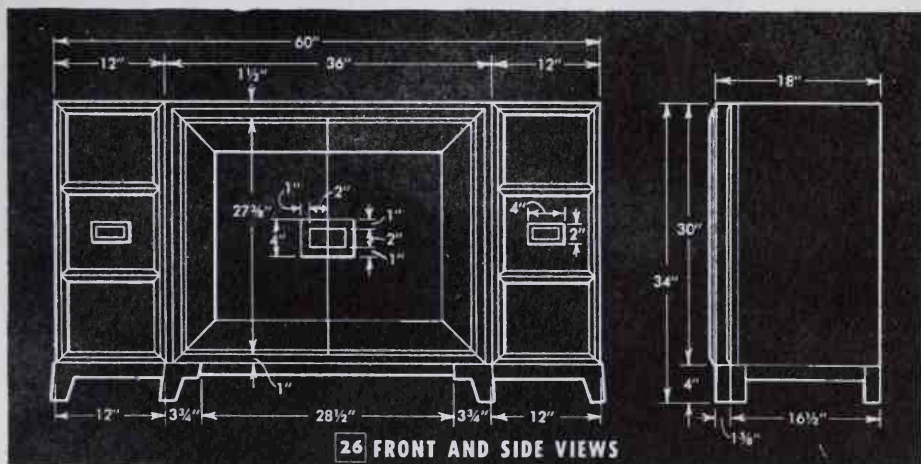
25



DINING ROOM FURNITURE

WITH THE table and chairs completed as detailed in Part I, you should be ready to tackle the more pretentious pieces of the dining-room group — the credenza and the china cabinet. Construction of the credenza is fairly simple as revealed in the

cutaway drawing in Fig. 28. Over-all dimensions for this piece are given in Fig. 26, and a view of the interior, Fig. 27, shows how the doors are hinged, where friction catches are installed and how finger pockets in the rails are provided to facilitate



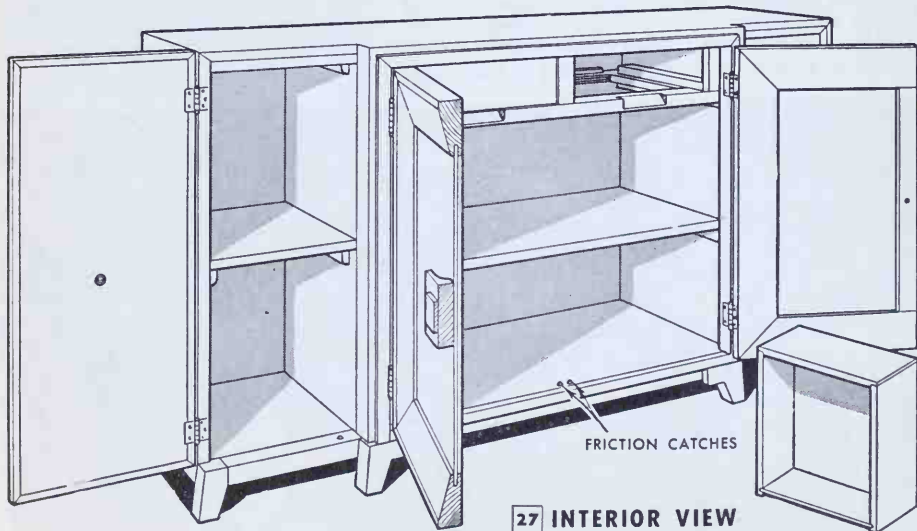
removal of the two silverware drawers.

Start the credenza by making the base framework. Each end is made up exactly the same, right and left hand, and then joined together with front and rear members. Section A-A in Fig. 28 gives the sizes of these members and shows how they are screwed together. Note that the $\frac{3}{4} \times 1\frac{1}{2}$ -in. strip placed on edge runs the full length of the base and is glued and doweled to the two rear legs. All legs are the same size and shape, six being required, three of which are made for the right side and three for the left. All are doweled to the rails. Note that the outside faces of the end rails are beveled to match the flare of the legs. Section D-D shows how intermediate rails are rabbeted along one edge to receive $\frac{1}{4}$ -in. plywood bottoms. Cleats are fitted on the three other rails to support the plywood. Center legs of the credenza are doweled to the face of the front rails 12 in. in from the corner. Then, the $1 \times 1\frac{1}{8}$ -in. strip is screwed to the projecting ends of the rails and small overlay blocks are used to conceal the screwheads. Section A-A shows how the back rail is built up of two additional pieces, both being the same length and set between the intermediate rails.

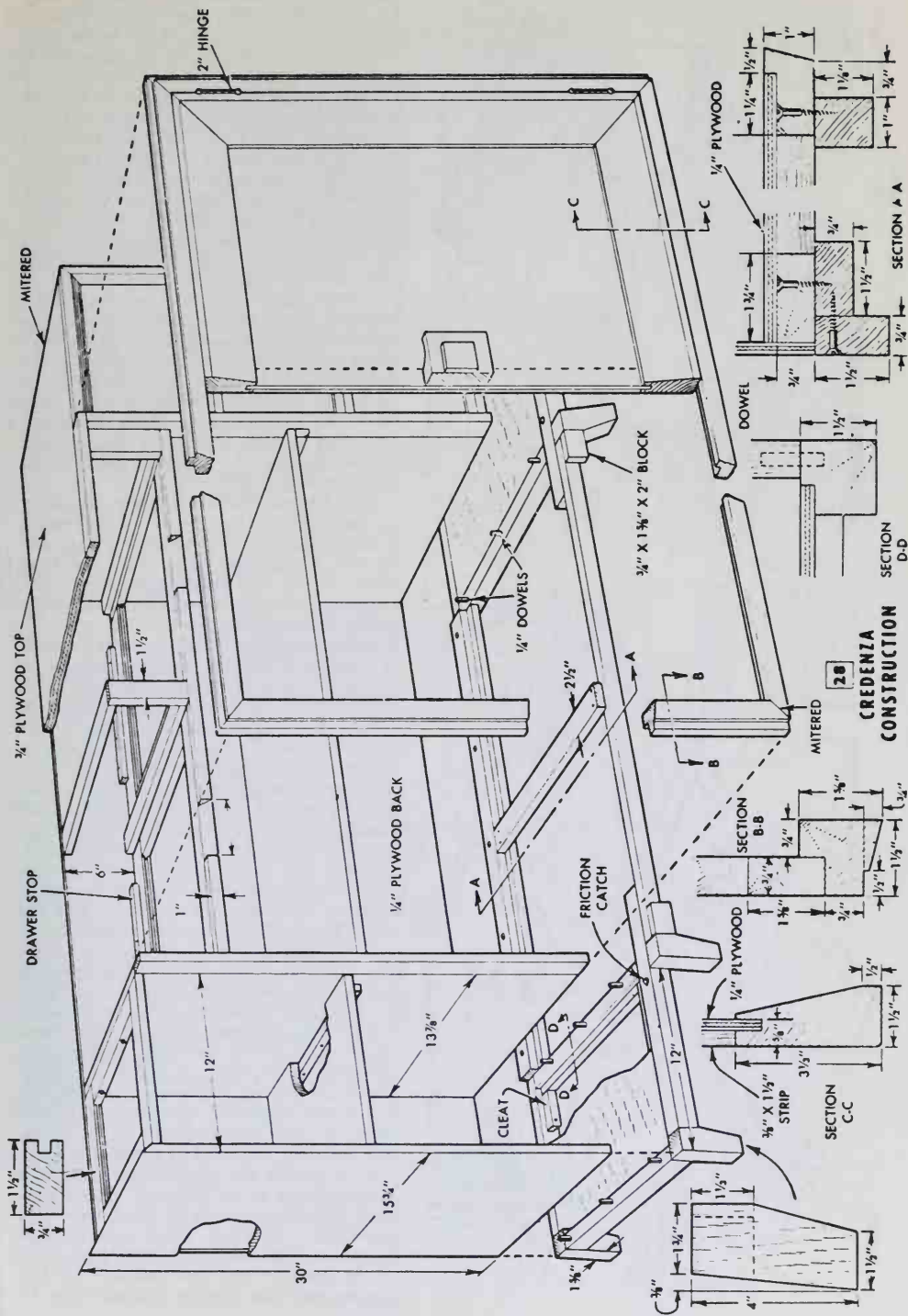
Next, the side members of the end compartments are installed. These are cut to size from $\frac{3}{4}$ -in. plywood. The upper ends of the outside panels are mitered 45 deg. while the lower ends are trimmed off squarely and bored for three $\frac{1}{4}$ -in. dowels, which are located in the base to bring the outer panels flush with the rail. The rear edges of the two outer panels are rabbeted for a $\frac{1}{4}$ -in. plywood back. The inner panels of each compartment are made $\frac{3}{4}$

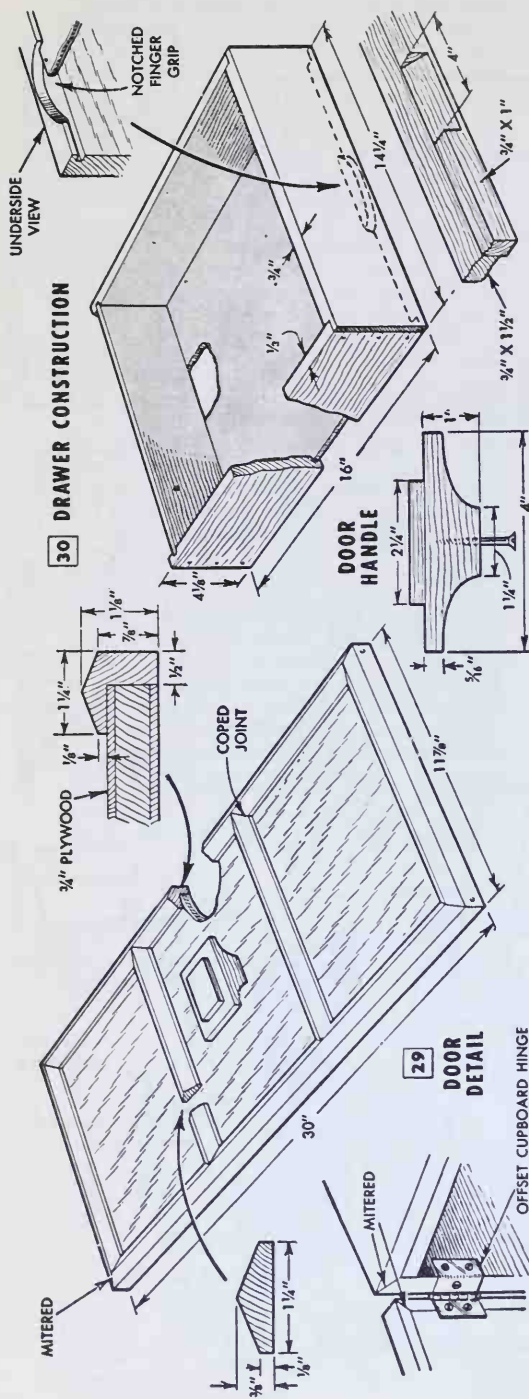


in. shorter than the outer ones and narrower to permit covering the plies of the wood with a $\frac{3}{4} \times 1\frac{1}{8}$ -in. strip of solid stock as detailed in section B-B. This strip is edge-glued and may be doweled for additional strength. The two panels of each unit are held together at the top with a frame of $\frac{3}{4} \times 1\frac{1}{2}$ -in. stock. Front and rear pieces of the frame are grooved on the inside edges for tenons on the sidepieces. The frame is screwed in place through the edge so it is even with the bottom of the miter and flush with the top of the inner



27 INTERIOR VIEW





panel. The plywood back is added next to strengthen the assembly. This is nailed into the rabbets of the outer panels, to the edge of the inner panels and to the framing at the top and bottom.

Next comes the top. This is cut 15 3/4 in. wide and is mitered at each end to make a perfectly fitting joint with the end panels. As in the case of the inner panels, a 3/4 x 1 5/8-in. strip of solid stock is edge-glued to the top to build it out flush with the sides. With this done, the center door molding is applied. Sections A-A and B-B give the size of the molding. The side and top members are rabbeted on the outer edge to fit over the edge of the top and inner panels, while the bottom member is rabbeted to take a 1/4-in. plywood bottom panel. Facing edges of the molding are beveled according to the sectional views and mitered to fit perfectly at the corners. Note, however, that the center shelf and the drawer frame should be installed before the molding is applied.

The drawer frame is made similarly to the frames at the top of the end units. Drawer runners are installed in the center and at each side after the frame is in place. Note that the front edge of the frame is faced with a hardwood strip which is notched at a 45-deg. angle to provide a finger pocket for each drawer. While the dimension for this is missing in Fig. 28, it is included in Fig. 30. The center doors are built up according to section C-C. They can be made in one piece by framing 1/4-in. plywood with a heavy molding grooved to fit over the edge and then sawing in half. A 3/8 x 1 1/2-in. strip is used to reinforce the plywood along each side of the saw cut. Construction of the doors for the end units is detailed in Fig. 29. Plywood is framed with a rabbeted molding to conceal the laminations, and overlay strips, coped at the ends, are surface-glued to the plywood to divide the doors into three equal panels. Regular offset cupboard hinges are used on the end doors, while 3-in., loose-pin hinges are used on the center doors.

The china cabinet consists of two separate units which are held together at the back with a cleat. If space is so limited that you can accommodate neither the large credenza nor the complete china cabinet, just the base of the latter can be built and used as a small server. Fig. 31 shows the general construction of both units of the cabinet. Top, sides, back and dust panels of the lower unit are 1/4-in. plywood. Top and bottom frames are joined at the back with 3/4 x 1 3/4-in. posts which are notched for the shelves and two drawer frames. Fig. 32

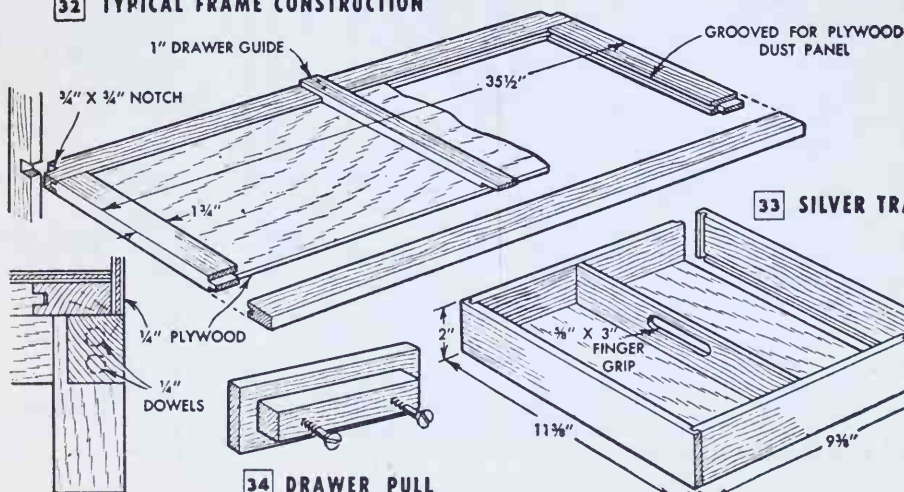
shows how the drawer frames are assembled. The top and bottom frames are supported at the front by a rabbeted molding which is mitered and assembled as a picture frame and then glued to the front edges of the frames at top and bottom. Side and top panels fit the rabbeted molding as shown in section D-D. Section C-C shows how the bottom frame is screwed to the base. Note that the top panel is rabbeted at each end to overlap the side panels. Drawers are assembled as in Fig. 30 and made to fit the openings. A grooved runner which rides on the guide is nailed to the underside of each drawer. Fig. 34 shows the simple wooden drawer pull. If desired, a silverware drawer can be included, Fig. 33. A bevel is run around the outer edges of the doors $\frac{1}{4}$ in. deep and $1\frac{1}{8}$ in. wide to give a raised panel effect.

The top unit of the cabinet is made like a box from $\frac{3}{4}$ -in. plywood. Sections A-A and B-B show how the pieces are rabbeted at the front edge to receive a molding which covers the laminations. Note that the rabbets at the top and bottom are made wide enough to house a standard showcase door track (see section A-A) and that rabbets also are made along the sidepieces to provide end grooves for the sliding glass doors. Note in section B-B that a groove is run at the front and back edges of the sidepieces for a standard adjustable shelf pilaster. In ordering glass panels for the doors, notice in section A-A that they must be short enough to permit inserting in the top track and then down into the lower one. Use crystal glass as it is less expensive. Any glass shop can grind the finger grips.



The china cabinet makes the seven-piece group complete. Featuring sliding glass doors, it's designed as two separate units to simplify moving and to permit base alone to be built and used as dinette server

32 TYPICAL FRAME CONSTRUCTION



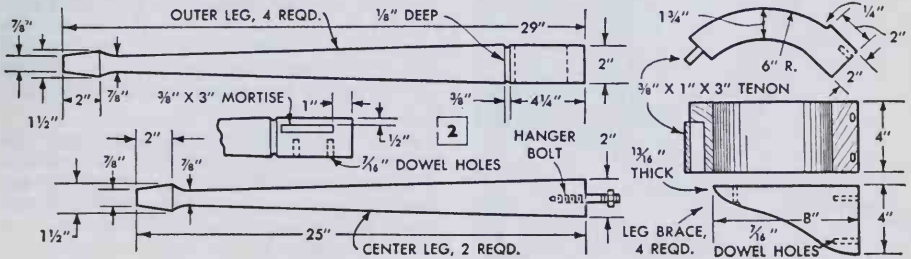
33 SILVER TRAY

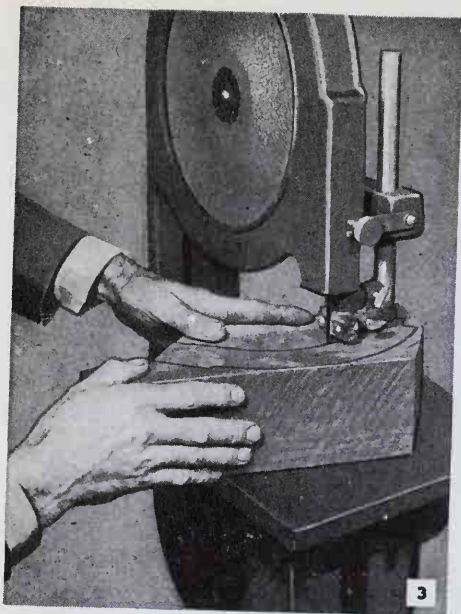
34 DRAWER PULL



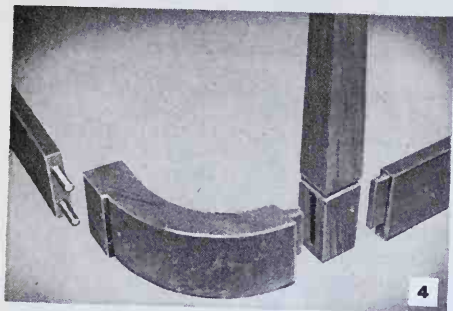
SHERATON DINING SUITE

TO HOME CRAFTSMEN with a liking for truly fine furniture of period design, building this Sheraton dining suite can add up to a lot of pleasure and profit. Although the general lines and design contours of both the table and chairs are characteristic, the construction details have been modified to make the assembly as simple as is consistent with good, sound construction. While most period furniture of this type is worked in mahogany with contrasting woods used rather sparingly as inlay and overlay accents, this dining suite is made throughout of solid walnut without any added decoration. The table is of standard size and the top is fitted with slides so that it can be opened for insertion of

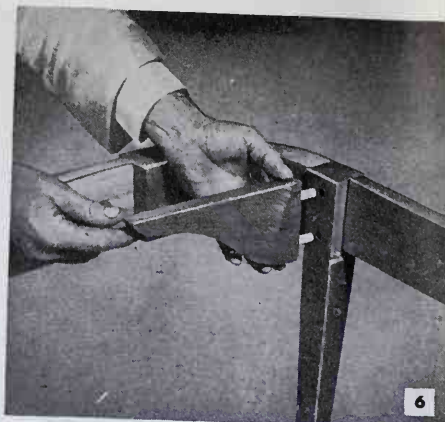
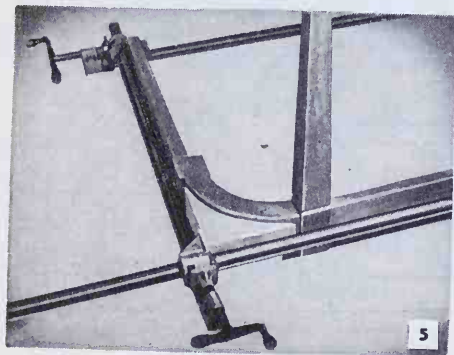




Curved corner sections of the table apron are band-sawed from solid stock. Three cuts form outer curve



Above, make a trial assembly of all the parts to check fit of joints. This assures a rigid table. Below, when clamping the parts, pressure must be applied in two directions because of curved member



After assembly of the aprons and legs, the leg braces are glued in place. Clamp until the glue sets

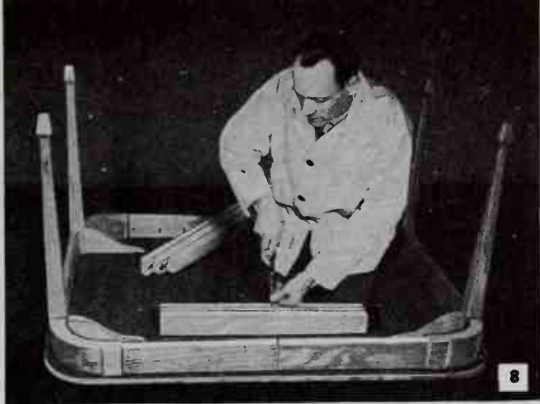
separate leaves. The top is glued up in two sections, each dimensioned as in Fig. 10. Use narrow pieces and select them carefully for matching grain and color. Joint the meeting edges of all pieces square with the face and use three $\frac{3}{8}$ -in. spiral dowels in each joint. Although not essential in this type of construction, waterproof glue is preferable. After the glue is thoroughly dry, sand both faces of each top half smooth, cut the corner radii on the band-saw and sand the edges. Then, drill holes for the aligning pins in the inner edges of the table-top sections. Cut the pins for the holes from $\frac{3}{8}$ -in. dowel, taper one end of each and glue in place in one of the halves. Make sure that the halves will close tightly. If the pins are too long, file them shorter.

Next, bandsaw four outer legs and two center legs from 2 x 2-in. stock, following the details in Fig. 2, but keeping in mind that sizes given in Fig. 2 are finish dimensions. Make allowance on all four faces for sanding out the saw marks. The curved corner sections of the apron, Fig. 3, and the leg braces, the right-hand detail, Fig. 2, are bandsawed from 4 x 4-in. solid stock. Note the offset in the outer curved face of the apron section. This must be bandsawed in three separate cuts, the first one being run in from the outside to form the shoulder. Mortise the outer legs and drill each one for $\frac{7}{16}$ -in. dowels as in the center detail of Fig. 2. Now, work out the end and side apron pieces and the supporting cleat for the center legs as in the right-hand details in Fig. 10.

Now, with all holes drilled and mortises and tenons made as detailed, the table is ready for assembly. The apron and leg are assembled at each corner as in Fig. 4 and glued and clamped as in Fig. 5. Make a trial assembly before applying glue, to



Center legs are bolted to a hardwood cleat screwed to the slides. Use hanger bolts

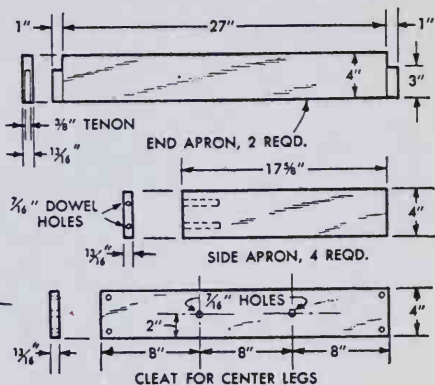
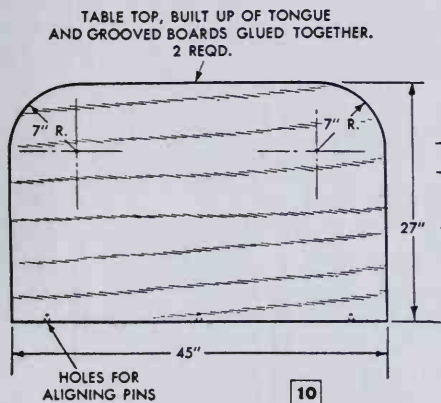


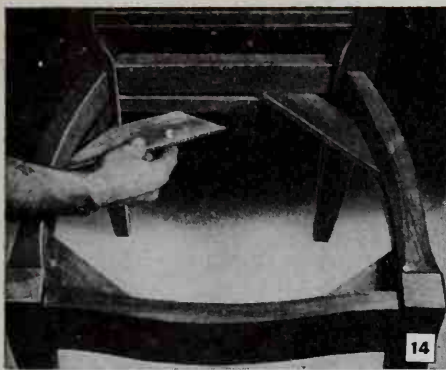
When assembling, the table top is turned upside down on level floor so that the legs and aprons can be accurately positioned

check the fit of all parts. After the final assembly has been made and the glue is dry, glue the leg braces in place as in Fig. 6. Next, turn the table top upside down on a level floor and invert the leg-and-apron assemblies over it as in Fig. 8, making sure the parts are properly positioned. Then attach the slides and center legs as shown in Figs. 7 and 8. The slides are of the ready-made type and are easily obtainable at nominal cost. The aprons can be attached to the table top by either of two methods: By means of what are known as screw pockets—holes drilled at an angle into the back face of the apron and through the top edge—or by means of triangular glue blocks reinforced with screws driven into the top and apron. On



Table and chairs are finished in the natural color of the wood with a colored filler, sealer and then either varnish or wax





Assembly of the chair frame showing how diagonal braces are glued into the grooves cut in the rails

the original, the top was attached by means of equally spaced screw pockets which you can see on the apron in Fig. 7. The pockets are made by first drilling with a special bit having a circular cutting edge to form a seat for the head of the screw, then counterboring with a small bit for the body of the screw. However, this is not practical unless you have a drill press and special bits available. Lacking this equipment it is better to use triangular glue blocks.

Dining suites usually include a host's chair having arms, Fig. 1. Other than the arms for the one chair, the construction of all chairs for this suite is simply duplicating the parts detailed in Figs. 11 to 13 inclusive. Assembly of the chair frames and the simple upholstery of the seats is detailed and pictured in Figs. 13, 14 and 15. In some instances, the assembly can be simplified even more than that shown. For example, Fig. 14 pictures the use of corner braces fitted into grooves cut in the rails. If equipment is not available for routing the groove in the curved rails, the braces may be omitted and metal corner braces substituted. In the right-hand detail, Fig. 13, the routed face in the upper and lower back rails can be omitted without impairing the symmetry of the chair backs. Also, the beads on the back splats can be omitted if desired. The lower details in Fig. 12 show how to cut the chair arms from solid stock and Figs. 16 and 17 picture the assembly of the arm. Keep in mind that both right and left-hand parts must be cut for a pair of arms.

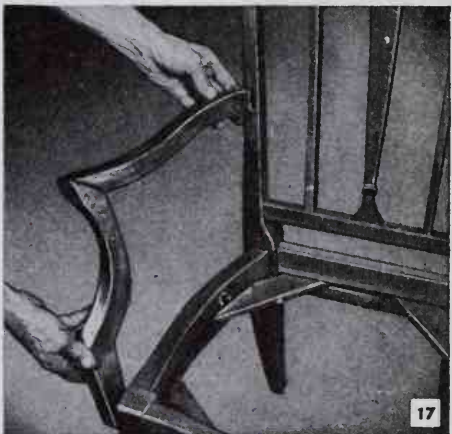
The original suite was finished, Fig. 9, in the natural color of the walnut, using a filler colored to match the wood. After filling, apply a sanding sealer. When dry, sand this coat smooth and apply two coats of varnish, or apply paste wax over the sealer and polish. If only a two-coat varnish finish is applied, sand between coats.

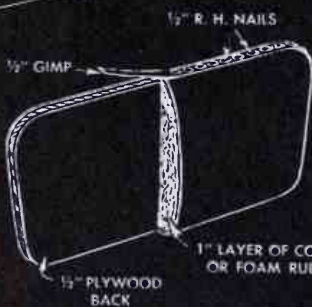


Upholstery is a simple padding over plywood base and covered with fabric or tapestry of your choice

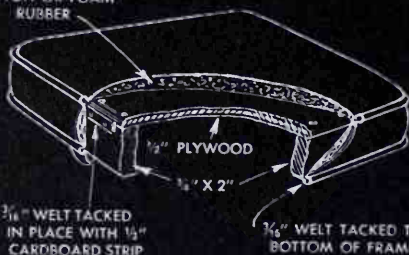


Above, two-piece arm of the host's chair has a splined joint for added strength. Below, arm is mortised into back leg and attached to front leg with screw



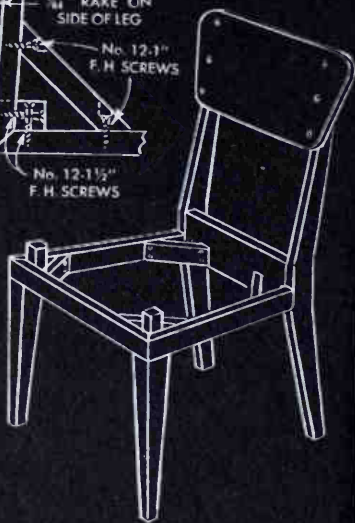
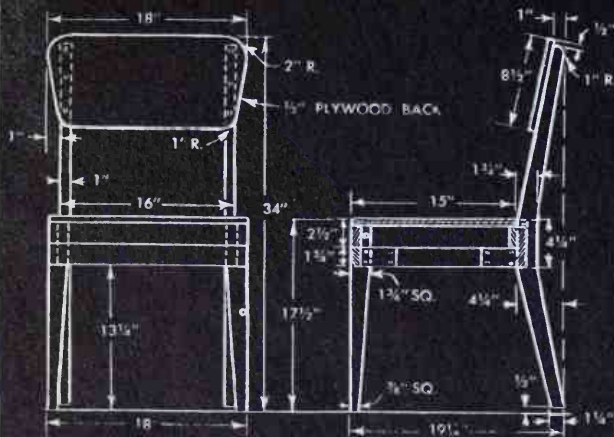
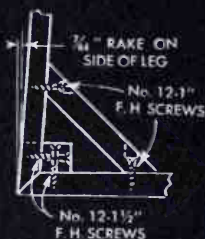


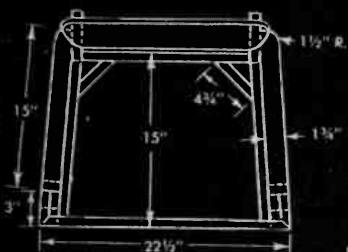
DETAIL OF WELTS
AND SEWING OF
COVER. ALLOW $\frac{1}{4}$ "
FOR ALL SEAMS



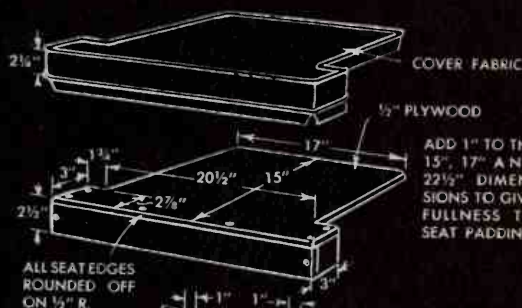
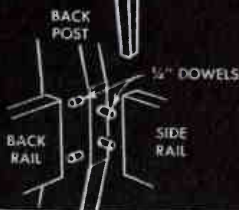
$\frac{3}{16}$ " WELT TACKED
IN PLACE WITH $\frac{1}{4}$ "
CARDBOARD STRIPS

3/8" WELT TACKED TO
BOTTOM OF FRAME





1" X 1 1/4" FILLER BLOCK

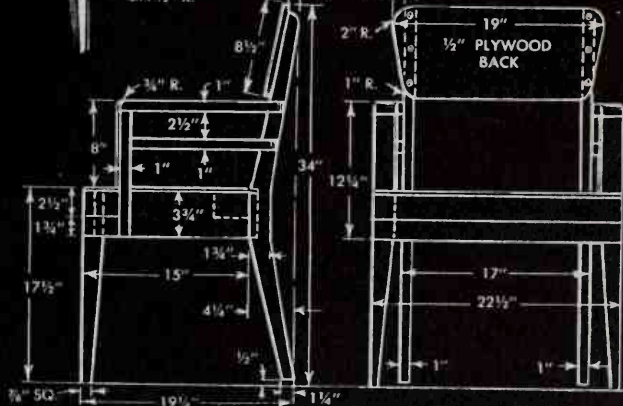


COVER FABRIC

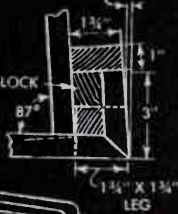
1/2" PLYWOOD

ADD 1" TO THE 15", 17" AND 22 1/2" DIMENSIONS TO GIVE FULLNESS TO SEAT PADDING

ALL SEAT EDGES ROUNDED OFF ON 1/2" R.



1/4" RAKE



1 1/4" X 1 3/4" LEG

MATERIAL LIST

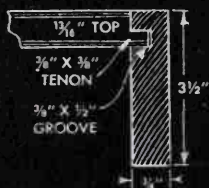
Chair with arms

- 1 pc.—1/2" x 8 1/2" x 19"—Back (plywood)
- 1 pc.—1/2" x 15" x 22 1/2"—Seat (plywood)
- 2 pcs.—1" x 4 1/4" x 33 1/2"—Back posts
- 2 pcs.—1 3/4" x 1 3/4" x 16 3/4"—Front legs
- 1 pc.—3/4" x 1 3/4" x 22 1/2"—Front rail
- 2 pcs.—3/4" x 3 3/4" x 14 3/4"—Side rails
- 2 pcs.—3/4" x 1 3/4" x 3"—Front side rails
- 1 pc.—3/4" x 4 1/4" x 15"—Back rail
- 2 pcs.—1" x 1 3/4" x 11 1/4"—Arm stumps
- 2 pcs.—1" x 1 3/4" x 15"—Arms
- 2 pcs.—1" x 1 3/4" x 13 1/2"—Arm rails
- 1 pc.—3/4" x 2" x 22 1/2"—Front seat rail
- 2 pcs.—3/4" x 2" x 2 1/4"—Side seat rails
- 2 pcs.—3/4" x 1 3/4" x 4 3/4"—Corner braces
- 2 pcs.—1" x 1 9/16" x 1 3/4"—Filler blocks
- 1 1/2 yds. of 1/2" gimp
- 2 1/2 yds. of fabric, 54" wide
- Foam rubber or cotton padding

Armless chair

- 1 pc.—1/2" x 8 1/2" x 18"—Back (plywood)
- 1 pc.—1/2" x 15" x 18"—Seat (plywood)
- 2 pcs.—1" x 4 1/4" x 33 1/2"—Back posts
- 2 pcs.—1 3/4" x 1 3/4" x 16 3/4"—Front legs
- 1 pc.—3/4" x 1 3/4" x 18"—Front rail
- 2 pcs.—3/4" x 1 3/4" x 15 1/4"—Side rails
- 1 pc.—3/4" x 4 1/4" x 14"—Back rail
- 1 pc.—3/4" x 2" x 18"—Front seat rail
- 1 pc.—3/4" x 2" x 16"—Back seat rail
- 2 pcs.—3/4" x 2" x 13 3/4"—Side seat rail
- 4 pcs.—3/4" x 1 3/4" x 4 3/4"—Corner braces
- 1 1/2 yds. of 1/2" gimp
- 2 1/2 yds. of fabric, 54" wide
- Foam rubber or cotton padding

DINING FURNITURE



TOP APRON

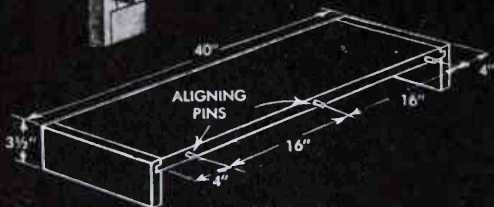
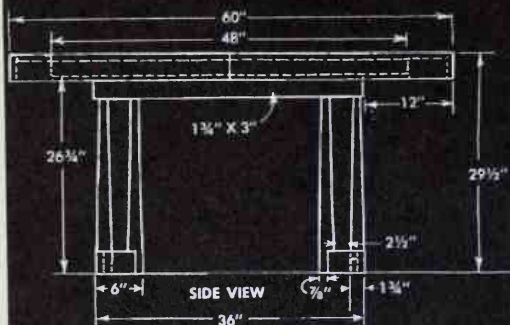
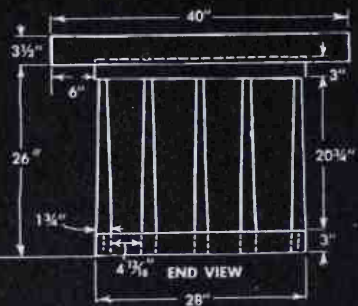


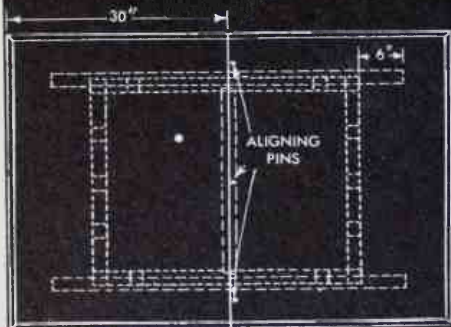
TABLE-LEAF DETAIL



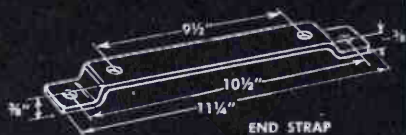
SIDE VIEW



END VIEW

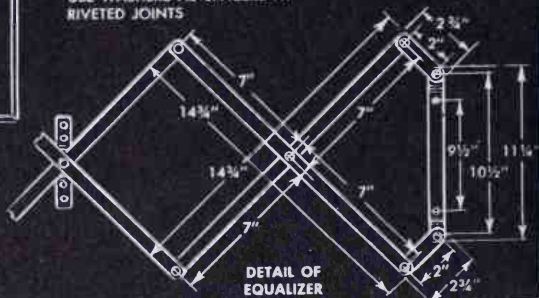


MITERED JOINT



END STRAP

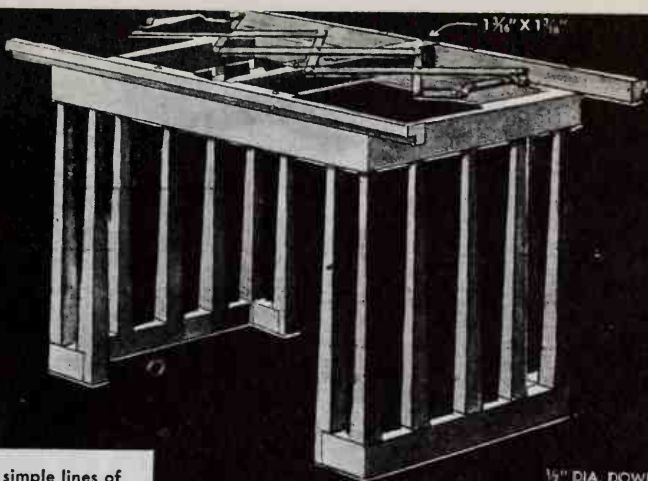
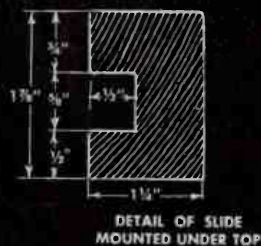
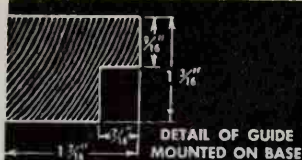
ALL PARTS OF EQUALIZER ARE MADE OF 1/4" X 3/8" FLAT STEEL. USE WASHERS AS SPACERS AT RIVETED JOINTS.



DETAIL OF EQUALIZER



CENTER BRACKET

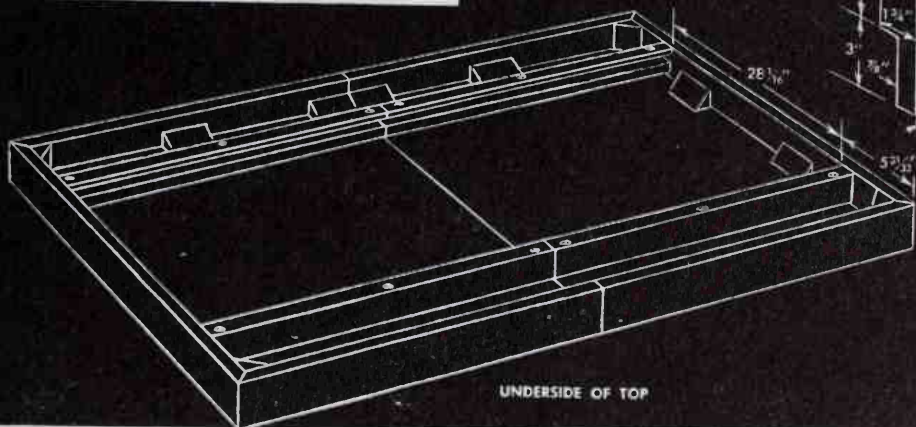
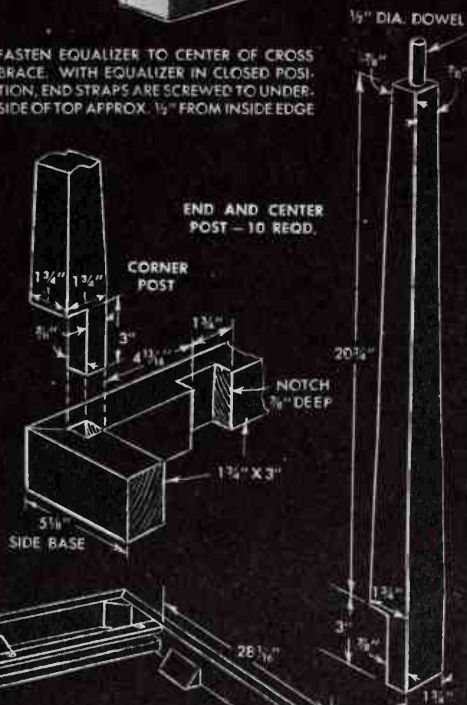


Designed to harmonize with the simple lines of modern home furnishings, this dining table has simplified construction features of special interest to craftsmen with limited equipment. Each pedestal is built up by joining seven tapered posts to a mitered base with half-lap joints. Top ends of posts are doweled to a subframe which supports the top. The latter is built up from two pieces of plywood, the aprons being strengthened by glue blocks as shown. Grooved members of the two-piece guide are attached to the underside of the top while the rabbeted members are screwed to the subframe. A parallel-arm equalizer prevents binding of the top extensions as they are opened or closed

MATERIAL LIST

- 2 pcs.—1 3/16" x 29 5/8" x 39 1/4"—Top (plywood)
- 2 pcs.—1 3/16" x 14" x 39 1/4"—Leaves (plywood)
- 4 pcs.—3/4" x 3 1/2" x 30"—Side top rails
- 2 pcs.—3/4" x 3 1/2" x 40"—End top rails
- 4 pcs.—1 3/4" x 3" x 28"—Base end rails
- 4 pcs.—1 3/4" x 3" x 36"—Base side rails
- 2 pcs.—1 3/4" x 3" x 36"—Side base rails at top
- 14 pcs.—1 3/4" x 1 3/4" x 23 3/4"—Posts
- 4 pcs.—3/4" x 3 1/2" x 14"—Leaf aprons
- 4 pcs.—1 1/4" x 1 7/8" x 29 1/4"—Top slides (maple)
- 2 pcs.—1 3/16" x 1 7/16" x 48"—Guides (maple)
- 1 pc.—1 3/16" x 1 3/16" x 26 1/2"—Cross brace (maple)
- 10 ft.—3/4" x 1/8" flat steel for top equalizer

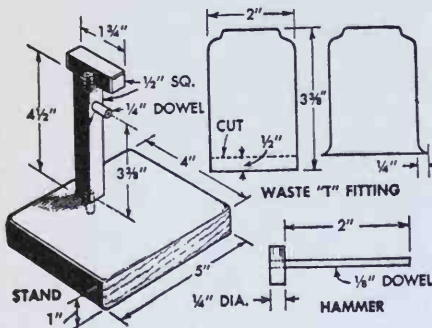
FASTEN EQUALIZER TO CENTER OF CROSS BRACE. WITH EQUALIZER IN CLOSED POSITION, END STRAPS ARE SCREWED TO UNDER-SIDE OF TOP APPROX. 1/2" FROM INSIDE EDGE



UNDERSIDE OF TOP

DINNER BELL

Say "Come and Get It" With This Tiny Dinner Bell



At dinnertime the soft tone of this tiny bell calls all hands at a single stroke. The bell is obtained ready-made from your plumber for it's simply a chrome-plated escutcheon, or cover, used in conjunction with a pop-up waste "T" fitting of a built-in drain plug on a lavatory. The straight end of the fitting is drawn and flared about $\frac{1}{4}$ in. by hammering it on a stake, which, in this case, is simply a 6-in. length of $1\frac{1}{2}$ -in., round cold-rolled steel. Use a soft hammer to avoid denting the metal. The stand is a good one-evening project. Use a cab-

inet wood that matches the dining table or sideboard for the base and upright. The bell is mounted by inserting a wood screw through the setscrew hole already in one side of the bell at the top and driving the screw into a hole drilled in the end of a short length of $\frac{1}{4}$ -in. dowel, as indicated in the left-hand detail. The head of the striking hammer is made from $\frac{1}{4}$ -in. steel rod and fitted with a wooden handle turned from the same wood as that used in the stand. Finish the stand with varnish or wax.



DINNERWARE IN WOOD

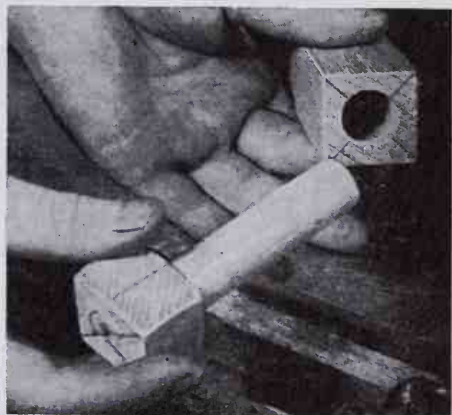
Includes salad bowls; dinner, dessert and serving plates; cream-and-sugar service; salt-and-pepper shakers, and coasters

TO COMBINE real luxury with easy informality, there's nothing quite like a complete service of wooden dinnerware, done in mahogany or other good turning wood of your choice. Whether gleaming in the candlelight beside your best crystal or waiting for the "hot dogs" at a back-yard picnic, these versatile dishes are right at home. The cost of the wood comes to a small fraction of the price of a complete set of similar tableware. The photo above pictures two place settings, including optional coasters for the tumblers, sugar-and-cream service, salt-and-pepper shakers and large salad bowl. The 14-in. serving plate is not shown, but is made in the same pattern as the smaller plates.

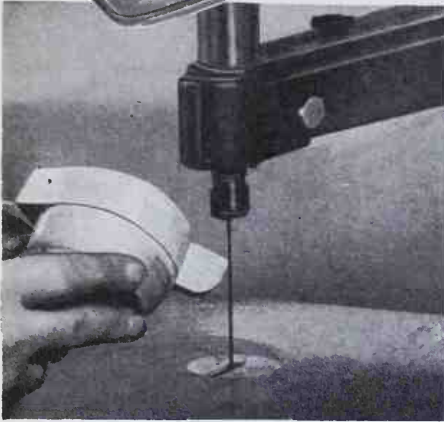
The plates and bowls are simple faceplate turnings. The same pattern is used for plates of different sizes, only the diameters being varied as indicated in the detail. The small salad bowls also follow the same contours as the large one. A mahogany turning block, $\frac{3}{4}$ in. thick for the plates and 2 or 3 in. thick for the bowls, is sawed to a diameter about $\frac{1}{4}$ in. greater than that of the finished piece. The blank is centered on the faceplate and the underside of the plate or bowl is turned. Then the work is reversed on the faceplate, and the top surface is turned, $\frac{1}{4}$ -in. faceplate screws being used so they will not penetrate the thin bottom of the piece. Blind holes formed by the screws on the undersides of the pieces are filled before finishing. Because of their



Above: contours of bowl turnings are checked with cardboard template. Below: hole is drilled in center of turning squares for salt-and-pepper shakers



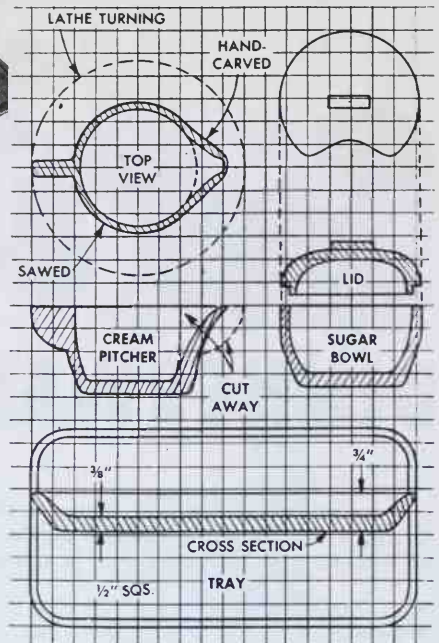
Sugar-and-Cream Service



Blanks for handle and spout of cream pitcher are sawed from flange on turning. Sugar spoon is half-size version of salad spoon shown on opposite page

location, the holes are unnoticeable when the service is in use. However, if you wish to eliminate the need for filling screw holes, glue the work temporarily to a block of scrap stock with paper sandwiched between the pieces, and screw the scrap to the faceplate. The large salad bowl is provided with a fork-and-spoon set which is made according to the squared pattern.

The tray for the sugar-and-cream service is made from a rectangular block of $\frac{3}{4}$ -in. mahogany. The inside of the tray is dished out with a round-nosed chisel, the chisel being worked from each end of the tray toward the center to prevent splitting the wood. Note in the details of the cream pitcher that a wide flange is turned on the upper portion of the work. After both the inside and outside contours of the pitcher have been turned to shape, waste stock is jigsawed from the flange, leaving only the blanks for the spout and handle. These are finished by hand with a wood rasp, pocket-knife and sandpaper. The sugar bowl is turned in the same way as the salad bowls. The lid is a separate turning and is completed without reversing the work in the lathe, the top of the lid being turned to the same diameter as the length of the handle



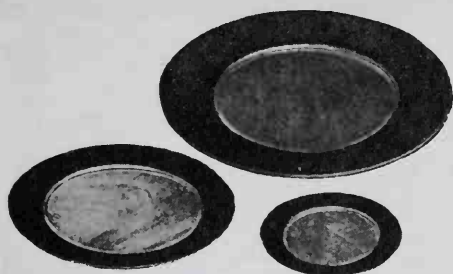
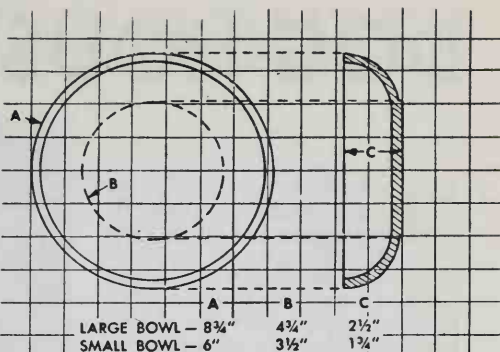
before cutting off the stock. After the turning has been cut off, the handle is cut to its rectangular shape with a coping saw.

The salt-and-pepper shakers are tapered turnings, drilled out from the bottom and plugged with a cork. The holes at the top of each shaker are made with a hand drill after the turning has been completed, and a thin score line around the shaker simulates a cap. Turning the shakers is simplified by drilling them first and fitting them with a wooden plug to facilitate mounting between centers. In the exact center of the turning square, a $\frac{3}{4}$ -in. hole is drilled deep enough to allow for any waste at the bottom of the turning and still leave a hole $2\frac{1}{4}$ in. deep in the shaker itself. This hole is fitted with a flanged plug turned from scrap lumber, as in the detail, the plug being sufficiently tight to keep the work from slipping. After one turning has been made, the plug is used again for the other shaker.

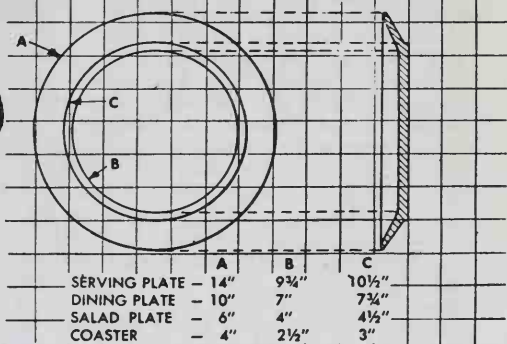
The pieces are finished by staining, sealing with a thin "wash" of shellac, filling and waxing or varnishing. Applying two coats of varnish that is both alcohol and heat-resistant results in a finish that will remain beautiful for years. The pieces are especially attractive when stained with a two-tone effect. This is done by staining the inside surfaces light mahogany and the outside portions dark.



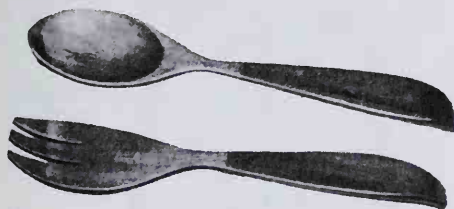
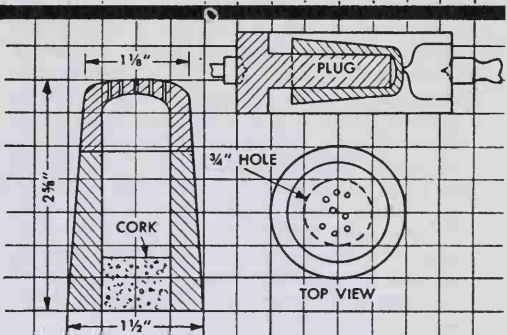
Salad Bowls



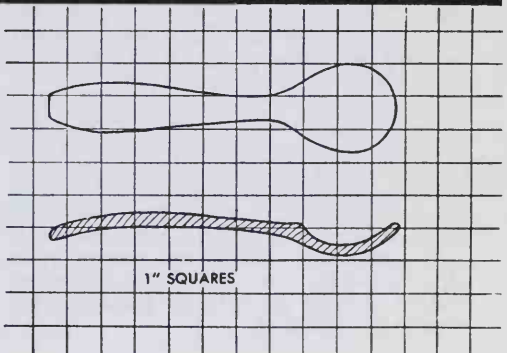
Serving Plates



Salt-and-Pepper Shakers



Fork and Spoon

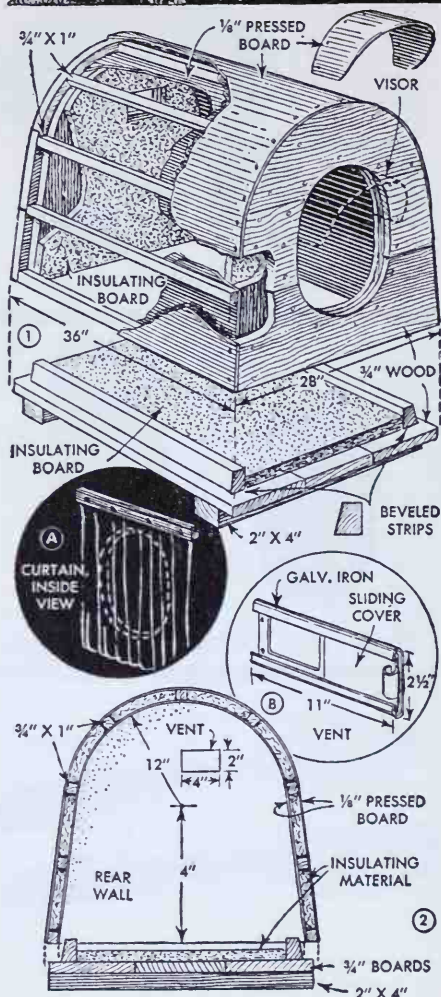
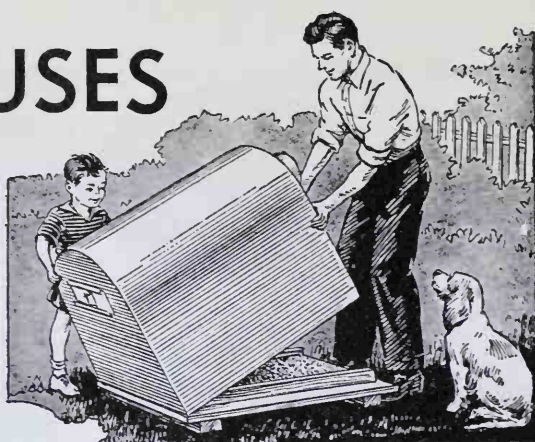


DOG HOUSES

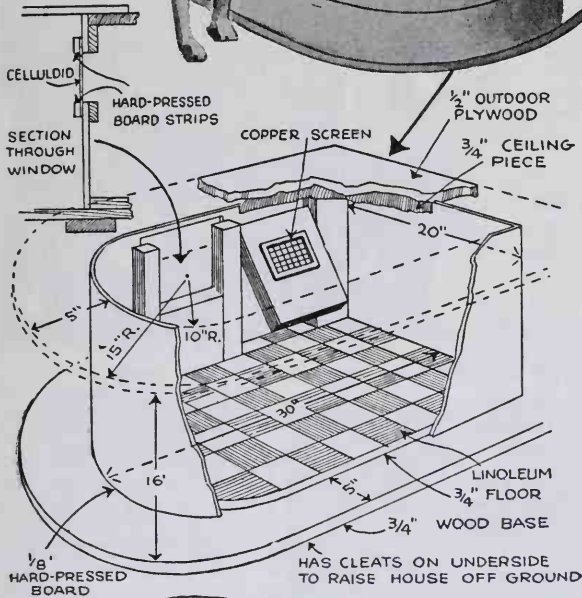
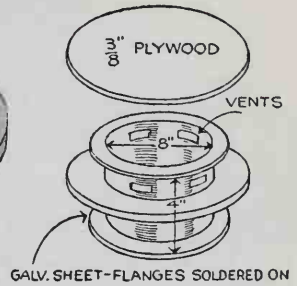
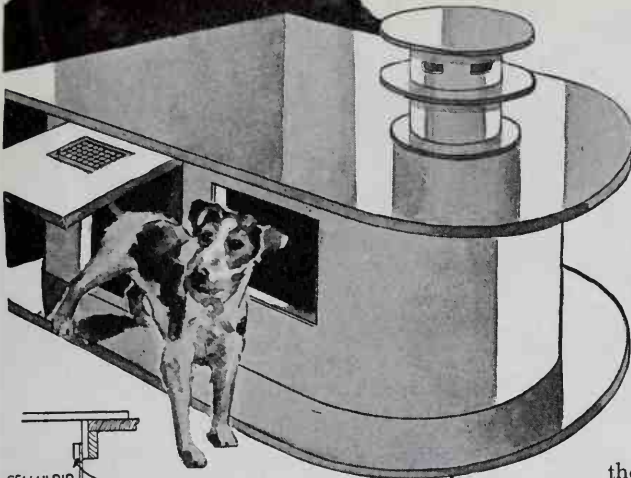
IT may be that every dog has his day but until that time he should have a home of his own and it should be snug, warm, well ventilated and clean. If you think as much of your pet as he does of you, just any place won't do. So his home will have to be something extra special and here's a good suggestion—a house patterned after the well-known Quonset hut and retaining the essential features of the full-sized structure. The double walls are sheathed inside and out with $\frac{1}{8}$ -in. hard-pressed board. Linoleum can be used but is not so durable for this purpose. Space between the double walls is filled with $\frac{3}{4}$ -in. soft-pressed insulating board cut to fit between the supporting strips as in Fig. 2. Ends are triple thickness: $\frac{1}{2}$ -in. wood, two thicknesses, with insulating board inside, as in Fig. 1. Note that the ends are shaped to form a $\frac{7}{8}$ -in. step which takes the $\frac{1}{8}$ -in. inner wall plus the thickness of the insulating board.

Dimensions given in Figs. 1 and 2 are about average. The house can be made larger but not much smaller due to the shortened radius of the curved top. Hard-pressed board will not take the bend satisfactorily on a radius much less than 12 in. as given. Make the ends first, using strips of solid stock nailed or screwed together with the grain at right angles as indicated. Or use $\frac{1}{2}$ -in. waterproof plywood if available. No size is given on the door opening, as this is optional. Size of the ventilator opening and the sliding sheet-metal cover are given in Fig. 2, B.

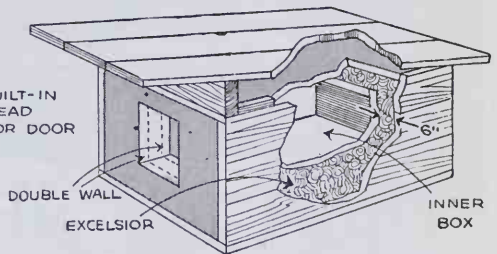
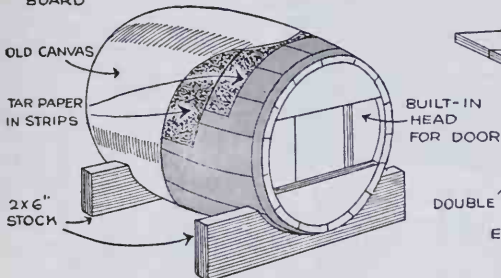
Assembly by nailing the inner wall to the ends. Space the nails about 1 in. apart. Then follow with the strips and the insulation. Outside sheathing should be cut so that it overhangs the ends and lower edges about $\frac{1}{8}$ in. This will prevent water working underneath and onto the floor. It's a good idea to coat all joining edges with paste white lead or waterproof glue before nailing the outer sheathing in place. Bottom construction is very simple. Ends of the hut should overhang the ends of the bottom boards about $\frac{1}{8}$ in. when the parts are assembled. The canvas curtain, A in Fig. 2, and the visor of $\frac{1}{8}$ -in. hard-pressed board or light sheet metal finish the job ready for painting.

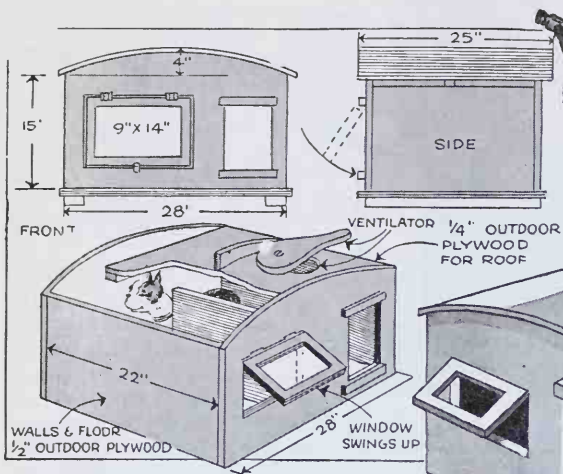


DOG HOUSES

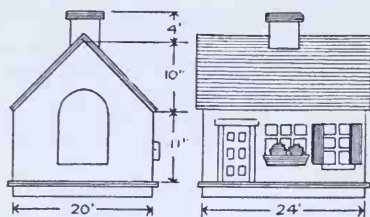


CALL them just plain doghouses if you will, it's certain your dog will be quick to show his appreciation of any one of them, and that in his own way. Most dogs won't be fussy about the architectural details; even canine aristocrats are not likely to turn away from a barrel house or a box with a lean-to roof, provided it's warm and clean. Looking at any one of these designs you will see that they fill the latter two requirements without even considering the degree of ornamentation on several of them. Taking the various designs left to right, the first one at the upper left is a rather showy affair of a distinctly modern type made of plywood and hard-pressed board. The detailed view at the left shows you how to



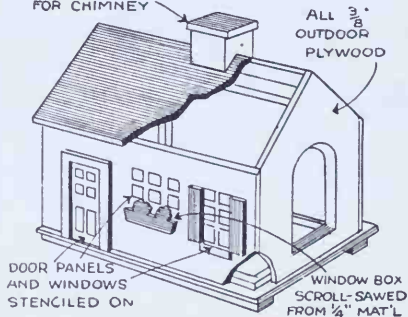
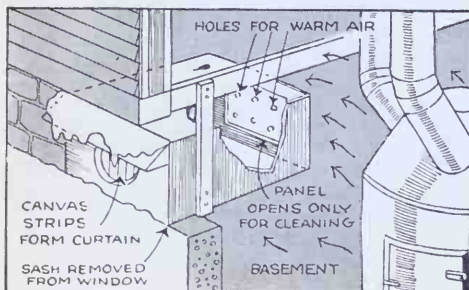


make it. Now, for bare utility combined with a bit of novelty, you have the barrel and the shed or lean-to kennels detailed at the lower left. The barrel is mounted on a cradle as you see and is covered with canvas. Painted white, it's neat and weather-tight. The other is simply a box within a box, the space between the double walls thus formed being filled with excelsior to insulate the interior. The "hangar"-type kennel at the upper left features a vestibule, adjustable ventilator and an up-swinging casement window. At the lower right you have the Cape Cod cottage which will house your pet in snug comfort the year 'round. Directly below is the basement apartment with ground-level entrance. Holes in the back permit warm air to enter.



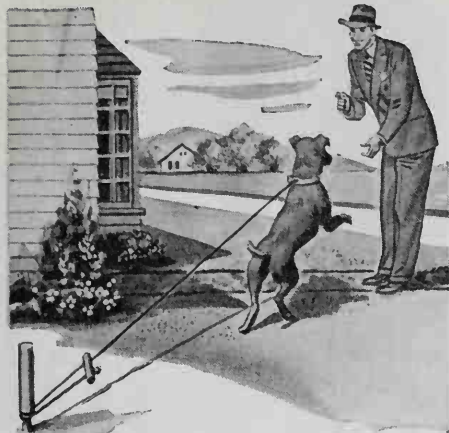
SOLID 4"x4" BLOCK FOR CHIMNEY

ALL $\frac{3}{8}$ " OUTDOOR PLYWOOD



DOGS

Length of Dog's Tether Adjusted With Tent-Rope Tightener



In order to protect his plants and shrubs, one man frequently finds it necessary to vary the length of his dog's tether when the animal is staked in different parts of the yard. To adjust the tether, he uses a tent-rope tightener made from a short length of dowel by drilling a hole through it near each end.

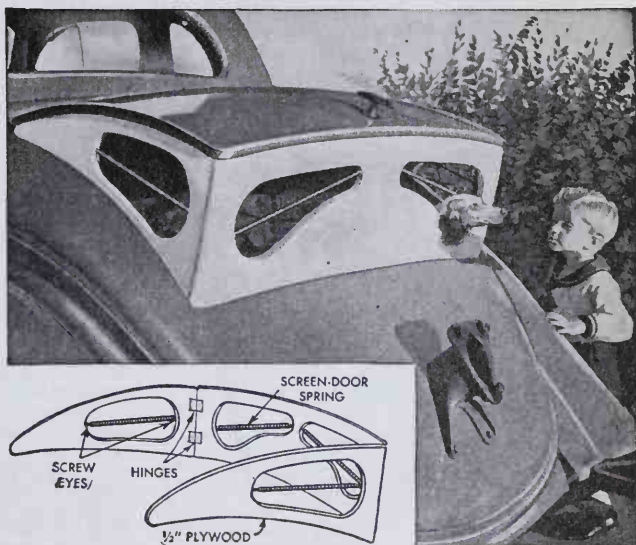
Dog House Has a Sliding Roof To Permit Easy Cleaning



By making the roof of a dog house movable, you can clean the house more easily and change bedding chips without the inconvenience of pushing them through the doorway. The house can be built of any scrap lumber, but redwood is best as it repels parasitic insects. The roof slides on two runners, and is held on them by cleats. For ventilation, a hole should be drilled through the gable at each end.

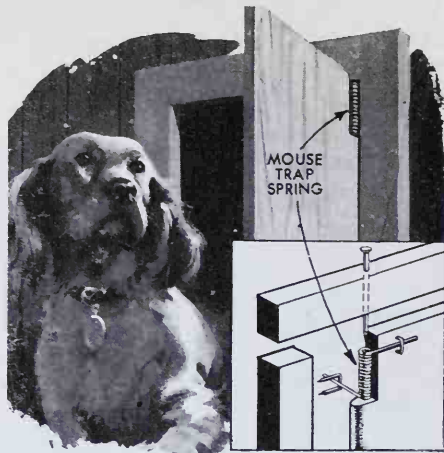
Taking the family dog along on a trip in a car, especially in a coupe, usually happens only once—the next time he is left at home. This was our experience until I converted the rear deck of the car into a separate compartment in which the pet could ride without disturbing others. I shaped the three pieces as shown to match the contour of the deck door, which forms the roof of the compartment, and hinged the three together so that the whole unit would fold compactly. Screen-door springs placed across the openings prevent the dog from jumping out and a large box provides a bed.

Folding "Dog House" Fits Auto Rear Deck To Keep Your Dog Happy on Long Trips

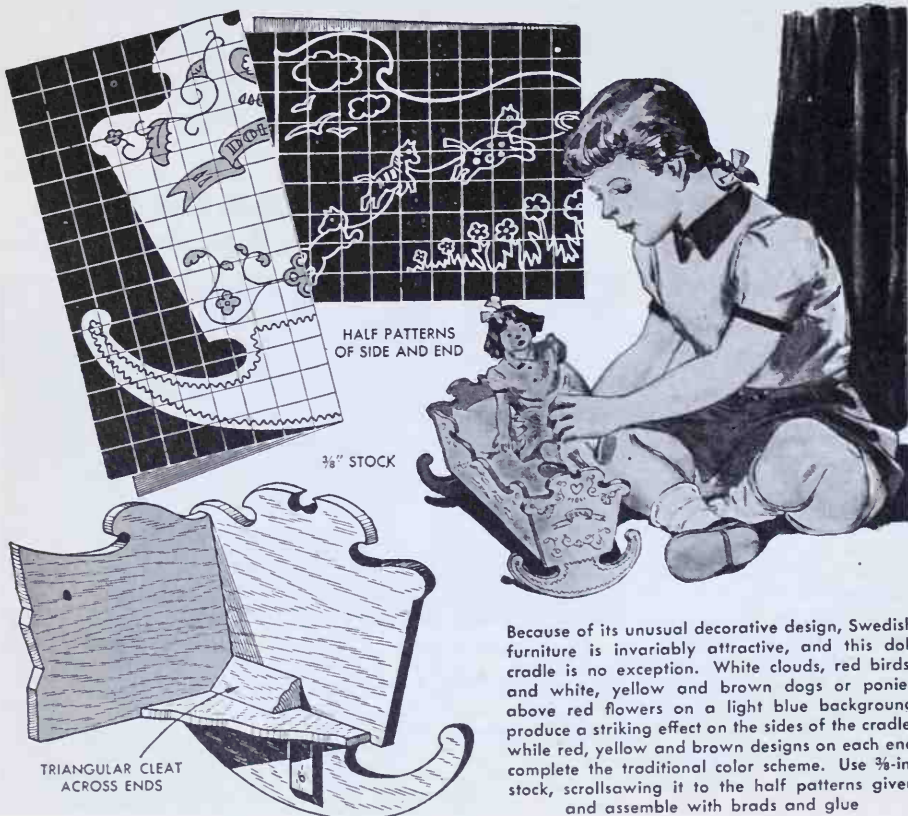


"Private" Entrance for Pets Features Spring-Hinged Door

This self-closing pet entrance allows your dog or cat to enter and leave the basement or porch as it pleases. Hinged on nails and returned with half a mousetrap spring, the door swings closed as soon as the pet has passed through it. The hinged side of the door is drilled to pivot on a nail at the lower corner. Several washers are slipped over the nail to keep the door from binding. The upper corner is notched and drilled for the end of a second nail driven through the top frame, the spring being placed over this nail and stapled to the panel frame so the tension will hold the door in closed position when your pet isn't pushing against it.

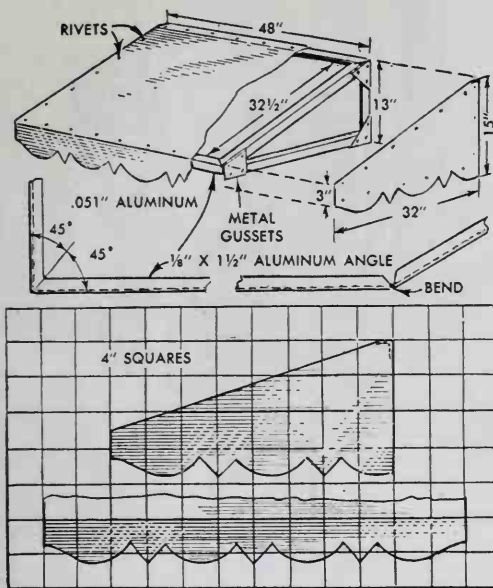


DOLL CRADLE



Because of its unusual decorative design, Swedish furniture is invariably attractive, and this doll cradle is no exception. White clouds, red birds, and white, yellow and brown dogs or ponies above red flowers on a light blue background produce a striking effect on the sides of the cradle, while red, yellow and brown designs on each end complete the traditional color scheme. Use $\frac{3}{8}$ -in. stock, scrollsawing it to the half patterns given and assemble with brads and glue.

DOOR CANOPY



This door canopy is supported by a rigid aluminum-angle frame to resist high winds and to prevent sagging. The slanting, or top, section of the frame is bent U-shaped from a single length of aluminum angle notched at the corners. This part is fastened to a second U-shaped section which forms the back. Lower members of the sides are separate lengths of angle, and the parts are held together with metal gussets riveted at the corners. The top covering is cut from sheet aluminum according to the squared pattern and is riveted to the top

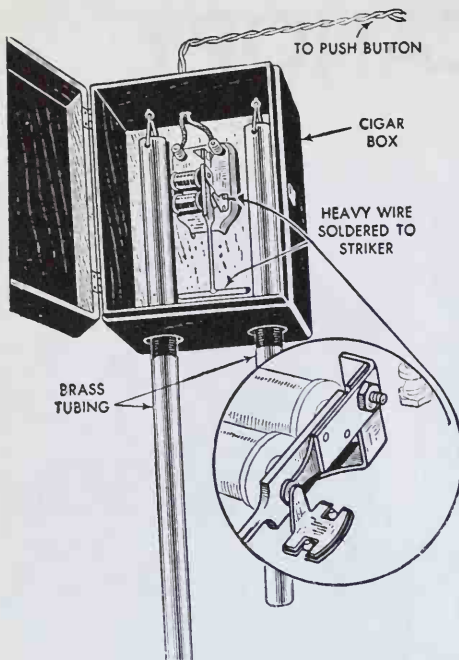
and back frame members. The covering for the ends is also cut from the pattern and riveted in place, using filler strips of aluminum between the gussets to give a smooth joint. The strips should be the same thickness as the gussets. Attach the canopy to a masonry wall with lag screws turned into expanding sleeves seated in holes drilled into the wall with a star drill. Use lag screws alone when attaching the canopy to a frame house. If desired, metal braces can be added as in the photo.

DOOR CHIME

Two-Tone Chime Improvised From Doorbell

By the simple alteration of a doorbell coil unit and the addition of two lengths of brass tubing you can make a two-tone door chime at very little cost. The bell is removed from the coil unit and the vibrating contacts are soldered together to transform the armature to single-stroke vibration. Then a length of heavy wire is soldered to the contact spring so that it projects at a right

angle under the coils as indicated in the diagram above. The unit is enclosed in a case such as a cigar box, oversize holes being bored through one end of the box to allow the 1-in.-dia. brass tubes to project below without touching the wood. Variation in tone is obtained by cutting one tube 30 in. long, the other 38 in., but to get just the right pitch it may be necessary to file



away the lower end of one or the other of the tubes, or both, by a cut-and-try procedure until the tone is satisfactory. The tubes are hung at the sides of the coils by cords.

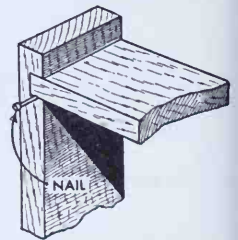
Some care in assembly will be necessary to assure that the tubes hang free in their respective holes and do not touch the box when the case is mounted on the wall.

How to Repair Doorbell Chimes

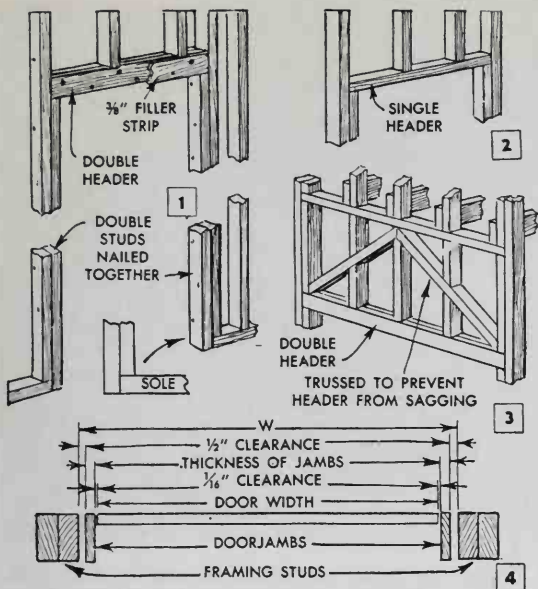
When servicing two-tone doorbell chimes that do not operate properly, I have found that trouble usually can be corrected easily as follows: Where the first tube struck is much louder than the second, this is remedied by covering the tube's striking surface with from one to three layers of friction tape, which softens, but does not flatten the tone. If the chime rattles or gives off a buzzing sound while the button is pressed, wrap the end of the spring next to the coil with several layers of tape, leaving about 2 in. of tape free. Then replace the spring and stick the free tape to the coil while holding the spring firmly against it. In case the tone of a tube is flat or muffled, just remove the plunger and file the striking end until smooth and slightly rounded. When one or both tubes do not sound at all, this is often due to corrosion on the plunger. To clean the plunger, remove it and polish lightly with a strip of fine abrasive paper. Also, it's a good idea to polish the guide by pulling a thin strip of abrasive paper through it several times, folding the paper lengthwise before inserting it to assure contacting the entire surface.

Finishing Nail Interlocks Joints In Door Jamb

Here's a trick one carpenter uses to interlock the joints when assembling door jambs. After nailing them together in the usual way, he drives a finishing nail in from the edge, letting it



straddle the joint as shown so that it partly embeds in the header and in the jamb, thereby locking the two together securely.



DOOR Construction and Repair

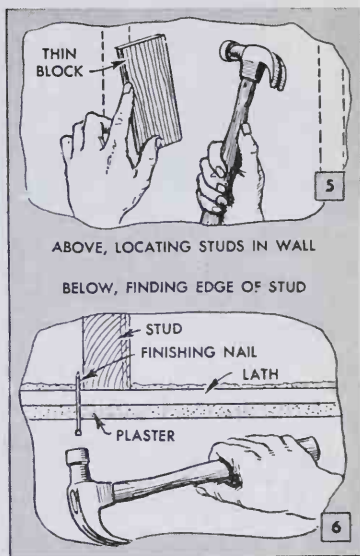
DOOR CONSTRUCTION

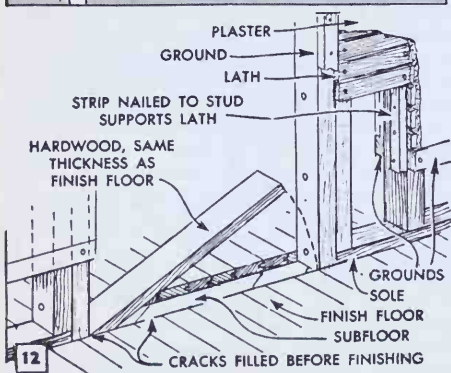
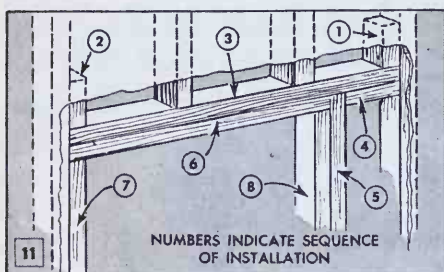
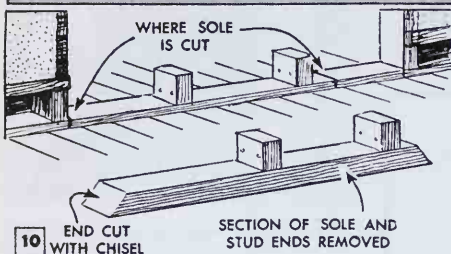
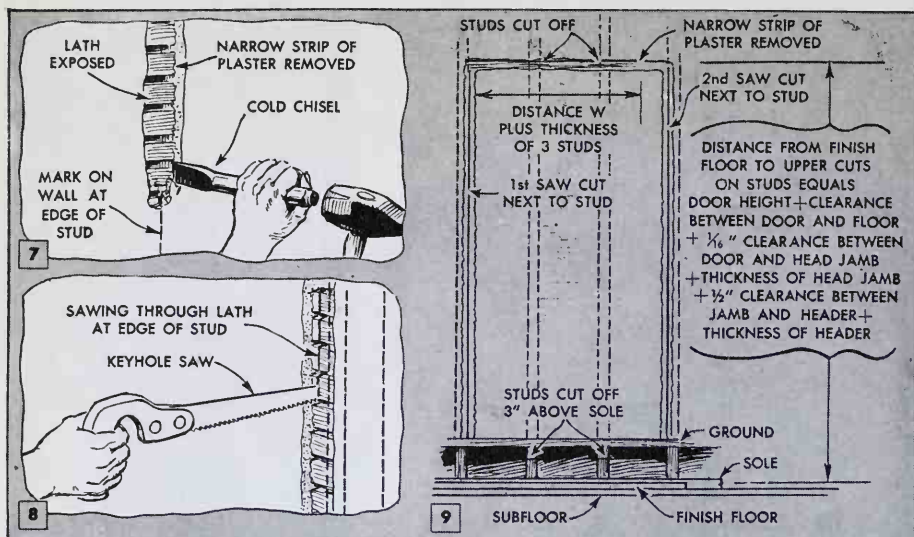
INSTALLING a new doorway in an added partition or relocating a door in a plastered wall are jobs that any careful homeowner can do. A door-frame is nailed to a sturdy framework of studs. There are double studs—two studs nailed together securely—on each side and a header across the top. In load-carrying partitions the header consists of two lengths of 2 x 4 or 2 x 6-in. stock set on edge and spiked together for maximum strength as in Fig. 1. Filler strips, such as wood lath, will make a double header come flush with the studs. A single header, Fig. 2, although generally not recommended, can be used in wallboard partitions not subjected to weight. Headers over all doorways 4 ft. wide or more should be reinforced by trussing, Fig. 3.

Doorway measurements: To determine the correct distance between the double studs of a doorway framework—distance W in Fig. 4—add together the door width, clearances and thickness of the door-jambs. Vertical measurements, which include the thickness of header, are given in Fig. 9. On outside doors allowance is made for a threshold above



After the door opening has been framed, cut the door to approximate size, install the hinges and then check for fit. A hand plane will enable you to shave down the edges of the door to compensate for the frame if it is slightly out of plumb

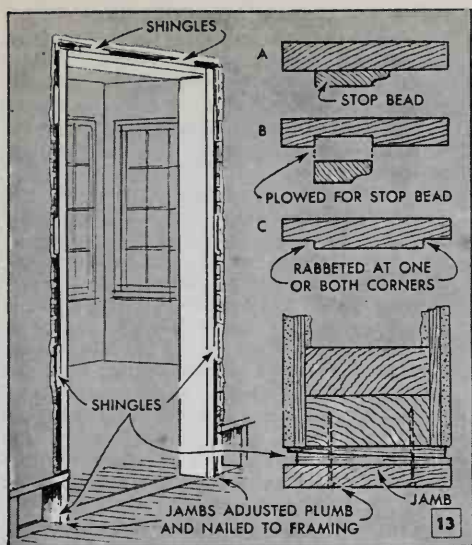




the finish floor when cutting the door to fit.

Changing doorway position: When changing the position of a doorway in a plastered wall, first make sure that there are no pipes or heating ducts in the partition where the doorway is to be located. Then remove the base shoe or quarter round and baseboard. Next locate the studs in the wall at the new position. If the plaster is not carried all the way down to the floor, but stops at a "ground" a few inches above the floor, the stud locations are obvious. If the plaster extends to the floor, studs are located by "sounding"—tapping as in Fig. 5—using a thin wood block to avoid hammer-head marks on the plaster. Locate the edge of the stud on the door side by driving in a finishing nail as in Fig. 6. Do this where the stud was located by tapping and also a few inches above the floor. Mark a pencil line between the two nail holes to indicate where plaster is to be chipped away with a cold chisel as in Fig. 7. Also push back plaster between the laths where sawing is to be done as in Fig. 8. Walls that are lathed with plasterboard are treated in much the same manner as wood lath in cutting a doorway. In the case of metal lath, shears are used to cut material when removing it.

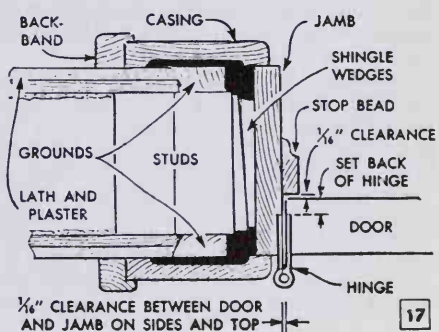
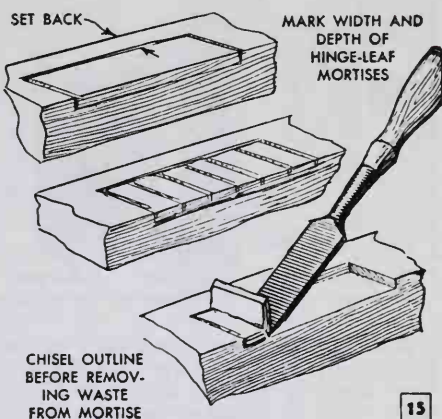
Next, measure off distance W of Fig. 4 from the saw cut, add the thickness of three studs — $4\frac{7}{8}$ in. — then locate the doorway edge of the next wall stud beyond this point. After marking, cut through plaster and lath as before. The same procedure is followed on both sides of the wall. Studs between the vertical cuts are sawed off at the bottom first, then at the top. If plaster runs down to the floor, remove a horizontal strip about 6 in. wide and saw the studs about 3

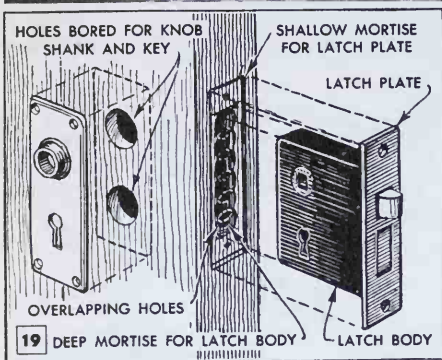
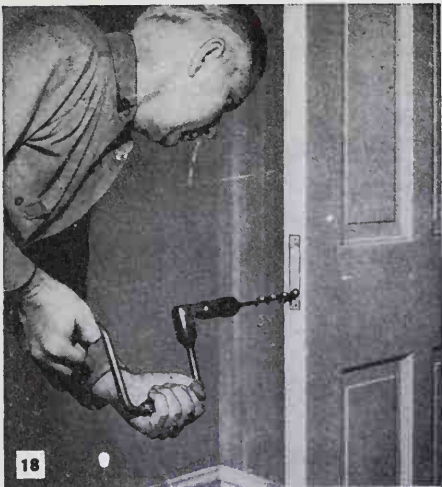


in. above the partition sole to avoid nails. A 2-in. strip of plaster and lath is removed across the top as in Fig. 9 to permit cutting off the studs at the top.

Now it should be possible to remove the cutout portion of the wall intact, after which the partition sole is cut off as indicated in Fig. 10, and the stud framework for the doorway is built following the sequence in Fig. 11. The joint at the bottom is shown in the lower details of Fig. 1. Lathing and plastering repairs are made as shown in Fig. 12. A strip of wood is nailed to the side of the stud where the old plaster ends to provide nailing support for the added lath or lath substitute. Other strips of wood of the same thickness as the plaster and lath are nailed along the edges of the opening to assure uniform thickness when plastering. These are "ground" strips, usually lengths of 1 x 2-in. stock beveled on one edge to "lock" the plaster. In applying wood lath it is customary practice to break the joints after each group of eight laths is applied to prevent plaster from cracking along a continuous joint. For plastering, it is advisable to get the services of a professional workman. Fig. 12 also shows how the floor can be patched with one or more hardwood boards of the same thickness as the finish floor.

Installing the doorframe is next. The head jamb must be horizontal and the side jambs plumb. Wooden wedges (butt halves of shingles) between the jambs and studs, Fig. 13, facilitate adjustment and provide nailing support. Use 10 or 12d finishing nails, and then apply trim pieces shown in Fig. 17. The stop bead generally is tacked on when hanging the door.





Hanging the door: By sighting, you can see which is the straightest edge of a door. This should be the latch edge since a slight warp can be corrected at the hinge edge by using a center hinge. On new doors the stile extensions are cut off first. Then the sides and top are planed to fit the jambs. There must be about $\frac{1}{8}$ in. clearance on each side and the top. The latch edge should be beveled slightly as in Fig. 16. On old doors planing to size is not done on the latch edge but on the hinge edge. The clearance at the bottom of an interior door should be about $\frac{1}{2}$ in. to avoid rubbing on rugs.

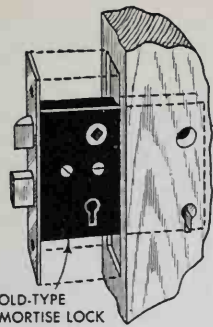
The stop beads are tacked in place temporarily while fitting the door which is inserted in the frame and removed a few times during the process of fitting. To mark door and jamb for hinges the door is wedged in the frame so that there is correct clearance all around. The surface should be flush with the edge of the jambs. Use a knife or scribe to mark the hinge positions on both door and jamb. Most interior doors have two hinges, one 5 or 6 in.

below the top, and the other 10 or 12 in. above the bottom. Make the hinge positions correspond to those on other doors within sight. Exterior doors generally have three hinges. For house doors $1\frac{1}{8}$ to $1\frac{3}{8}$ in. thick, $3\frac{1}{2}$ -in. butt hinges are used; for doors 2 in. thick or over 36 in. wide, 5-in. butt hinges are used.

Take the door down and mark the length and width of the hinge-leaf mortises, using a scribe as before. Carpenters use a special butt gauge for this purpose. After marking, make vertical chisel cuts around the outline of the mortise and then cut a series of chipping cuts to simplify paring to the right depth, Figs. 14 and 15. Hinge-leaf mortises should be a trifle deeper than the thickness of the leaves. On all house doors except those $1\frac{1}{8}$ in. thick, the hinges are set back about $\frac{1}{4}$ in. as shown in Figs. 15 and 17. All hinges on a door should have exactly the same setback; crosscuts of mortises must be precisely at right angles to the vertical edge of the door and the hinge pins must be in perfect alignment. After the hinge leaves are screwed to the door and jamb separately, the door is put in position and the hinge pins are inserted, the upper one first.

Jambs for most interior doors have the stop beads nailed on with 5 or 6d finishing nails, detail A of Fig. 13. Occasionally, in older construction, jambs are found that have stop beads set in plowed grooves as in detail B. Jambs for exterior doors generally have the jambs rabbeted as shown in detail C. There should be a clearance of $\frac{1}{8}$ in. between the door and stop bead at the hinge edge but the latch edge of a door should fit snugly against the stop bead to prevent rattling.

Fitting latches and locks: Most latches and locks are set into doors as shown in Fig. 19. To install a latch or lock, mark and cut the shallow mortise for the latch plate at the same height as those of other doors, which is usually about 36 in. above the floor. To make the deep mortise for the latch body, bore overlapping holes and then trim with a chisel. On cylinder-type latches only one or two holes are required instead of a mortise. As shown in Fig. 18, the door can be left in the frame and held securely with two wedges between it and the floor while cutting the latch mortise. After this has been done, bore the holes for the knob shank and the key, and screw on the side plates so that the knob shank will fit without binding. Then turn on the knobs and lock them with the setscrews. The strike plate is set into the jamb so that the latch bolt will slip into the hole when slight pressure is applied in closing the door. Be sure to locate the strike plate at the correct height so the bolt does not bind.



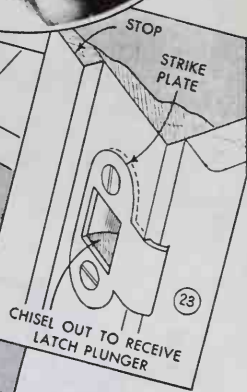
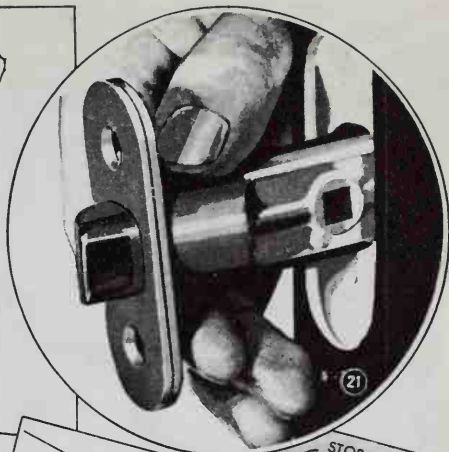
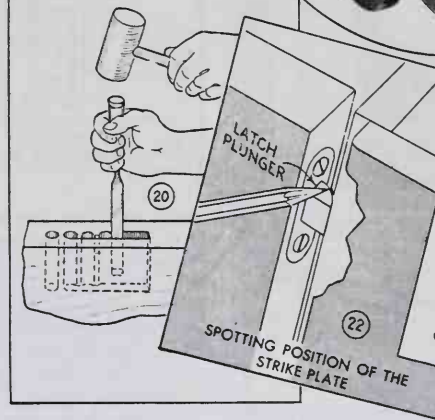
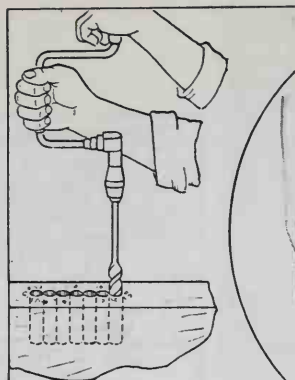
OLD-TYPE
MORTISE LOCK

Another method of installing the old-type mortise lock, illustrated above, requires very little chiseling. The illustrations in Fig. 20 show how the holes are drilled and the wood chiseled to form the mortise. Cutting the mortise is simply a matter of drilling holes. Careful placement of the striker plate is essential if a latch or lock is to operate smoothly without causing the door to bind or allowing it to rattle. Spot the position of the plate

by hanging the door, closing it and turning out the latch plunger so that it touches the jamb, as shown in Fig. 22. Do the same with the lock plunger if the set is a combination. Mark the location of the plunger, top and bottom, and carry these marks squarely across the jamb to a point corresponding to the depth at which the plunger is set back from the face of the door. Then place the plate in position over these marks and outline the mortise, and then spot the screw holes. Cut the mortise and screw the plate, as in Fig. 23.

Finally, adjust the stops to the latched door, allowing clearance for the paint or varnish finish and nail them permanently in place. Oil the hinge pins and latch to make the door work smoothly. Later on, if the door should bind due to swelling, do not attempt to trim off the lock edge, which would entail moving the lock. It will be easier to dress off the hinge edge and resink the hinges accordingly.

If you discover a hinge that has been improperly set, take the door down and unscrew the hinge from the jamb and recut its mortise to close up or spread the hinge,



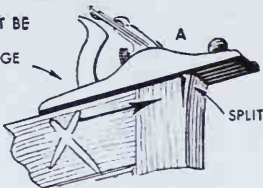
whichever is required. It may be necessary to shim up one side of the hinge with a strip of cardboard if too much wood has been cut away. Be sure to get the hinges out far enough to prevent the door from binding on the casing trim or striking the base block when the door is wide open. When hanging the door, do not set the screws permanently until the door has been adjusted to allow enough clearance.

Thresholds: When thresholds under outside doors become worn or splintered, they should be renewed. After removing the door and stops, it's easy to pry up the old threshold and install a new one. Thresholds are available in standard widths and after cutting to length, they should be painted or varnished on the underside before installation. Hardwood thresholds are preferable to those of softwood. Space between the door and the threshold should be sealed tightly when the door is closed to prevent entrance of cold air and water. An interlocking weather strip consisting of a saddle screwed to the threshold, and a metal strip screwed to the bottom of the door, will prevent air and water leaks. Usually the metal saddle is set in calking compound.



PLANE SHOULD NOT BE
DRIVEN OVER END
GRAIN TOWARD EDGE

OK

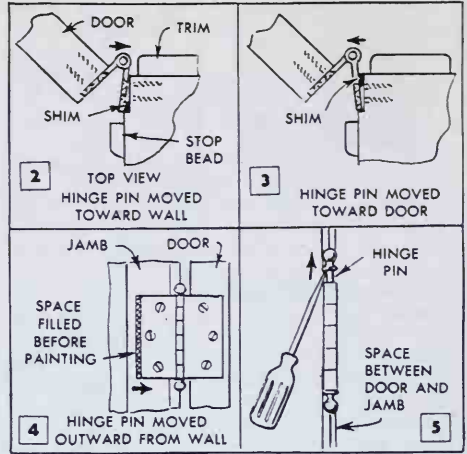


START PLANE AT CORNER
AND DRIVE IT TOWARD
CENTER. USE BLOCK
PLANE ON END GRAIN



DOOR REPAIR

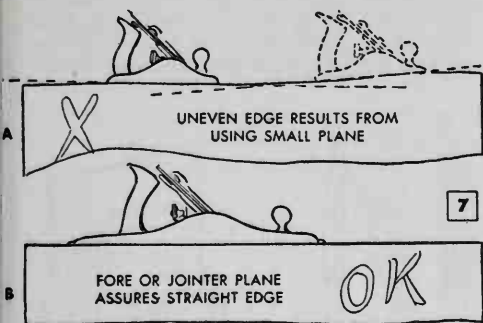
Doors that stick, rattle or fail to open and close properly are easily repaired and adjusted by the average homeowner without any outside help. No special tools are required to do a workmanlike job. In addition to the normal wear to which house doors are subjected, shrinking and warping of wood and settling of the building contribute to the causes of common door troubles. When properly hung, a house door should have a uniform clearance between its edges and the frame of about $\frac{1}{16}$ in. If this is not the case, it should be possible at least to insert a sheet of paper between the door and the jamb and draw it along from corner to corner unrestricted except by the latch and hinges. There also should be $\frac{1}{16}$ -in. clearance between the hinged edge of the door and the stop. When halfway open, the door should not tend to swing open or shut, nor should it bind at any point within the normal swing. Usually



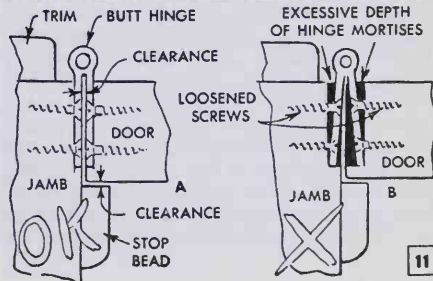
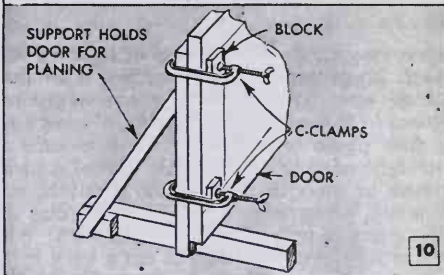
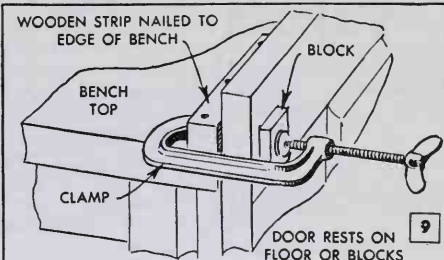
such troubles are caused by the hinge pins not being in vertical alignment. The hinge screws should be tight and the door should not rattle when fully closed. The latch plate must register with the striker plate so that both the latch bolt and the dead bolt engage the openings in the striker plate when the door is closed.

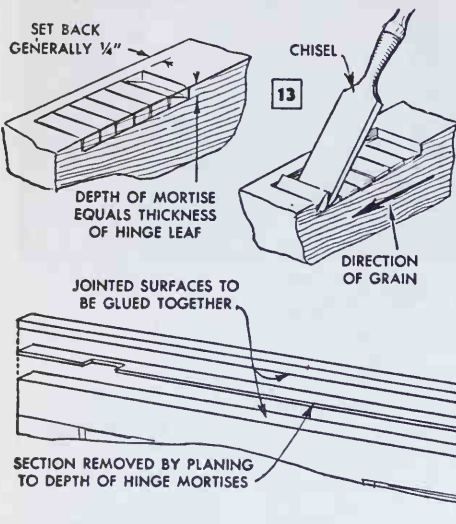
Sticking doors: Very often the cause of a sticking door can be remedied without planing either edge. First, check to see that the hinges are tight. Stand in front of the door edge and, with a hand on each knob, try moving the door toward and away from the hinges. If the hinges move, tighten the screws. If the screw holes are enlarged, drive in longer and larger screws. If the trouble does not show up in loose hinges, it is possible that the doorframe may have been forced out of square by settling of the house. Often it is possible to readjust the door by placing folded paper shims under the hinge leaves as in Figs. 1 to 3 inclusive. By positioning the shims under the front or rear edge of the hinge leaves, the pins are shifted toward the right or left as indicated by the arrows in Figs. 2 and 3. When using these methods, be sure that the space between the door and the frame is as uniform as possible after tightening the screws. If the hinges move as the door is closed, thinner shims will have to be used. When it is necessary to move the hinge pins out and away from either the stop or the wall in order to get them in alignment, the hinge may have to be reset on the jamb as in Fig 4, and the door brought into the exact position.

How to make those minor repairs and adjustments that help keep house doors in first-class working condition—simple jobs that any homeowner can do in spare time with only a few common household tools

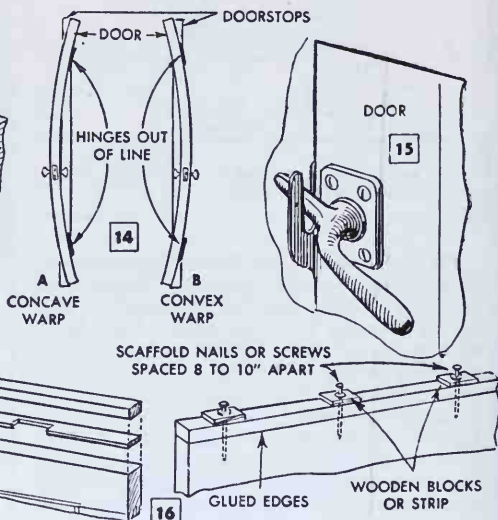


Planing door edges: When tightening of hinge screws or shifting of the hinges does not free a door that sticks, then the removal of wood from the edge of the door with a file or plane will be necessary. If the door sticks at the top or bottom try a coarse file first. If planing is necessary to remove more wood, use a block plane or a smooth plane on the end grain. When planing the ends of the stiles (vertical members of the frame of the door) always stroke the plane from the edge of the door toward the center, Fig. 6,B, to avoid splitting off the corners of the stiles, Fig. 6,A. When the door sticks along the latch edge, or if it cannot be closed, remove it from the frame so that the hinge edge can be planed. To do this, push a wedge under the door near the latch edge and remove the hinge pins, Fig. 5. If the door has three hinges, remove the lower and center pins first, then the upper one, after which the door can be lifted from the frame. Next, remove the hinge leaves from the door and support it rigidly on edge against a workbench as in Fig. 9, or make a door jack as in Figs. 8 and 10. Measure the exact width of the doorframe at several points from bottom to top. Transfer these measurements to the door and mark a gauge line along the hinge edge, allowing $\frac{1}{8}$ in. for clearance. Plane off the waste to the gauge line and deepen the hinge mortises, or gains, so that the hinge leaves will again be flush with the surface of the wood when screwed back in position as in Fig. 11,A. Rehang the door by simply reversing the procedure used in





running the chisel edge in from the side. This must be done with care to avoid cutting too deep and splitting the wood beyond the sides of the mortise. Center hinges are necessary on heavy doors and also are used on light doors to prevent warping. The size of the individual hinge required is largely determined by the size of the door. For standard doors $1\frac{3}{8}$ in. thick, $3\frac{1}{2}$ -in. butt hinges generally are used. For doors over 36 in. wide and 2 in. or more in thickness, 5-in. butt hinges are fitted. When repositioning hinges or installing them on new doors, avoid locating the hinge pins too close to the frame. This may cause the edge of the door to strike the stop. To as-



removing it. Spread a drop of light oil on each hinge pin before inserting it in the hinge eyes. When planing the edges of doors in the manner described, always use a fore plane or jointer plane to assure a straight edge as in Fig. 7,B. Use of a jack plane or smooth plane may result in an uneven, wavy edge as in Fig. 7,A, due to the short length of the plane bottom. Always set the plane blade to cut a very thin shaving. This will produce a smooth cut and will avoid removal of too much wood.

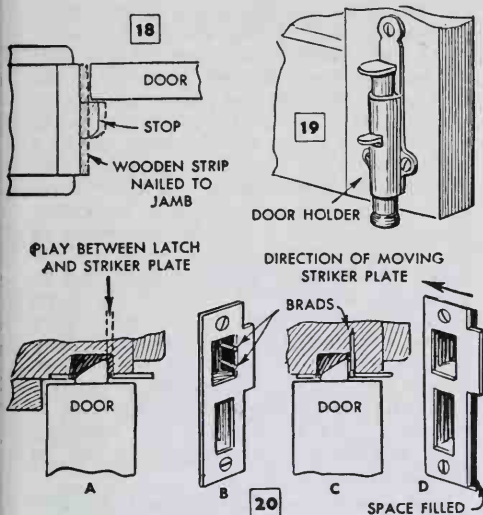
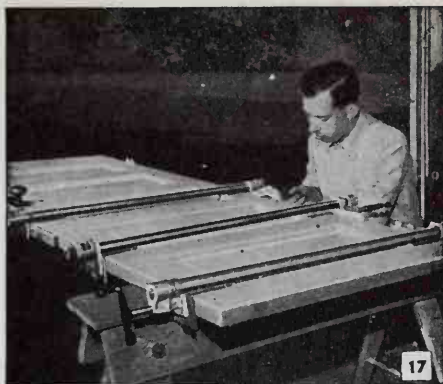
Hinge details: When hinge mortises are too deep, the edge of the door will press so tightly against the jamb when closed that the hinge screws are gradually pulled loose as in Fig. 11,B. This condition can be corrected by inserting cardboard shims under the hinge leaves. Hinges also may be loosened if the mortises in the jamb are slanted. When deepening or truing hinge mortises, make successive cuts with a chisel as in Fig. 13, and then pare out the waste by

sure free and noiseless operation, door hinges should be cleaned and oiled at regular intervals.

Warped doors: Doors that warp, Fig. 14, not only are difficult to open and close, but they cannot be satisfactorily weather-stripped or locked securely because of misalignment of the hinges and latch. Doors made from woods not thoroughly seasoned are more likely to warp excessively, especially if the thickness of the stiles and rails is $1\frac{3}{8}$ in. or less. A common remedy for either convex or concave warping is the installation of a third hinge midway between the other two. Care is taken to see that the pin of the middle hinge is in line with the other hinge pins. To install the middle hinge, mark the door and jamb as in Fig. 12. Then remove the door, cut the mortises and install the hinge leaves. When rehanging the door it will be necessary to apply pressure to the center to force the hinge eyes in line so that the pin can be

inserted. Sometimes only the stile on the latch edge of the door is warped, the other being comparatively straight. This problem is somewhat more difficult to solve, but it generally is possible to reverse an inside door and effect a satisfactory repair. The hinges and latch are transposed from one side to the other and the old hinge and latch mortises are concealed with filler blocks and plugs. These are sanded flush so that they will be concealed when the door is refinished. If paint or enamel is used, the repair will not be discernible.

Outside doors which are directly exposed to weathering and also to warm, moist air on one side and cold, dry air on



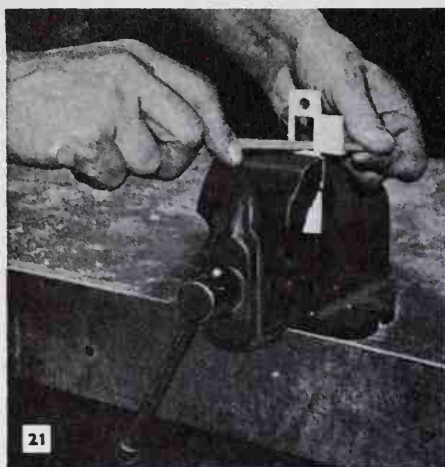
door as in Fig. 16. Remove the door, support it vertically with the door jack as in Fig. 10 and remove the hinge leaves. Then plane down the stile to the bottom of the hinge mortises, taking special care to joint the edges square. Then rip a strip from the same kind and grade of wood as that in the door and somewhat thicker than required to build the door out to the needed width. Spread waterproof glue on one face of the strip and also on the edge of the door stile. Then clamp the strip to the door edge with at least four bar clamps. If bar clamps are not available, scaffold nails or screws driven through small blocks and through the strip into the door stile at regular intervals will hold the edging in place until the glue sets. Remove the nails, or screws, after the glue is dry and fill the holes with putty. Plane the door to the required width, mortise the hinge leaves and rehang.

Another method of making a narrow door fit a distorted frame is detailed in Fig. 18. In this case, a thin strip of wood is nailed or screwed to the jamb on the latch side of the frame, and the stop and striker plate are replaced. If the stop is of the type not readily removable, then a narrow filler strip only as wide as the thickness of the door is used.

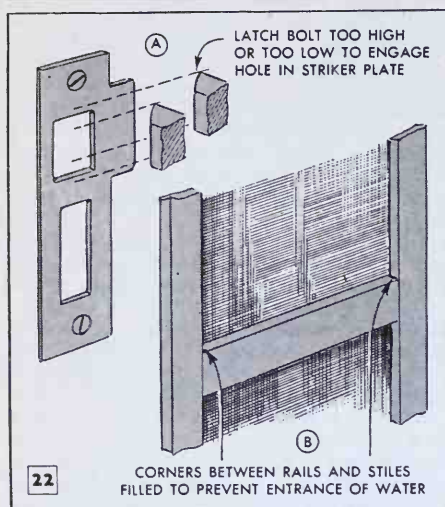
Regluing doors: Doors which are unprotected on the top and bottom edges with paint or varnish absorb considerable moisture during the summer months when the humidity is high. Changes in the wood due to swelling and shrinking eventually will break the bond of the glue in the joints, causing them to open. Filling the cracks will do little good as alternating changes in the dimensions of the parts will quickly break the crack filler loose. The only effective and permanent remedy for a door in this condition is to remove it from the frame and reglue the joints with waterproof glue. To do this, place the door on sawhorses and carefully pry the joints open with a narrow chisel or screwdriver.

the other, will warp if they are not well protected with an unbroken film of paint or varnish at all times. This protection should include both sides and all edges. Especially susceptible to damage by exposure are those doors which open onto porch decks, high terraces or patios. To keep such doors tightly closed and prevent warping it's often advisable to install extra latches of the type shown in Fig. 15.

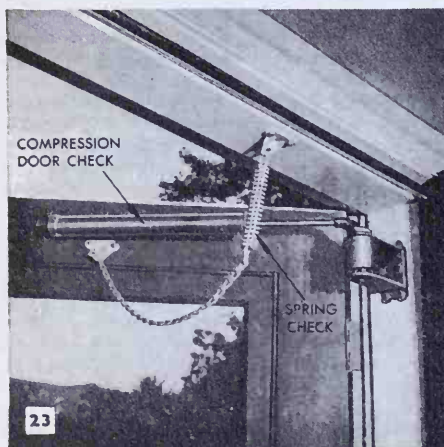
Doors that are too narrow: When settling of a house causes a doorframe to spread, sag or become distorted in any way, or when the door itself shrinks excessively because of the use of unseasoned wood, there may be too great a gap between it and the jamb to permit the latch bolt to engage the striker plate. For a temporary repair, thick cardboard shims or thin strips of plywood can be inserted under the hinges. A better and more permanent remedy for this particular condition is to glue a strip of wood to the hinge edge of the



21



22

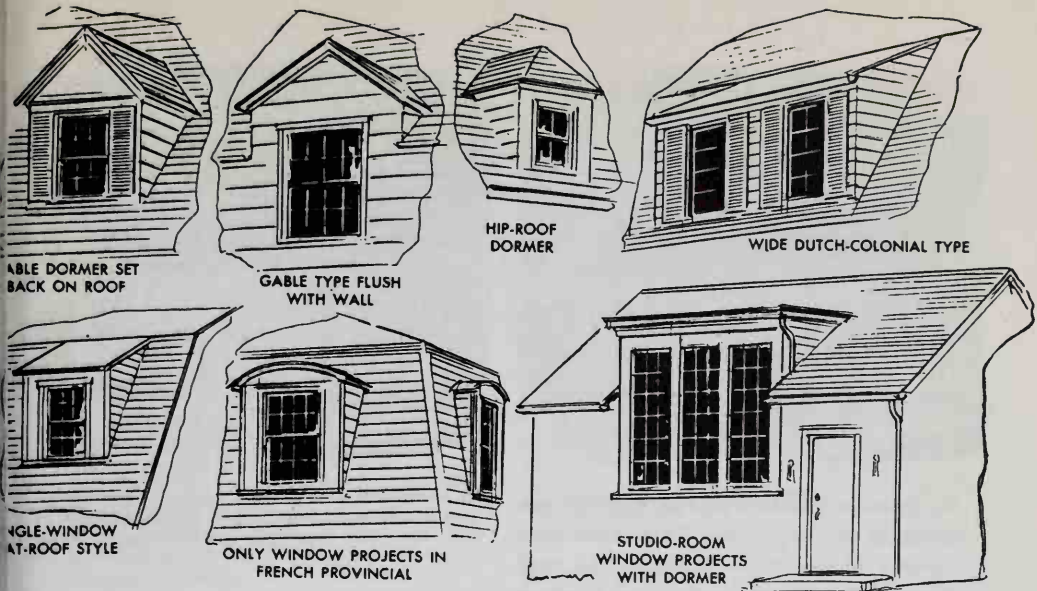


23

Spread glue liberally in the opened joints and immediately draw the parts together with bar clamps as in Fig. 17. Wipe off all excess glue with a damp cloth. Be sure that the glue is thoroughly dry before releasing the clamps. Then refinish the door and rehang.

Doors that rattle: One of the most common annoyances is a door that rattles. This can be caused by a draft of air and is especially troublesome if the latch bolt fits the striker plate loosely as in Fig. 20,A. Often, an effective temporary repair is made by driving one or two small brads into the wood under the striker plate so that the top ends will be flush with the surface of the plate as shown in details B and C of Fig. 20. This gives the same effect as moving the plate. Cut the heads off the brads if necessary and, if they still are too large, dress them lightly with a small file so that the latch bolt will slip into place when the door is fully closed. The permanent repair, of course, is to move the striker plate as in Fig. 20,D, or move the doorstep. Moving the striker plate generally is best as the stop may be splintered or the finish damaged in the process of moving it. In moving the striker plate, it will be necessary to pare the sides of the offset mortise to allow room for the latch bolt and dead bolt to slip home when the door is closed. If an open door slams hard as the result of a sudden draft from an open window, it may be extensively damaged. In some cases hinges and joints are loosened or broken. To guard against possible damage and, at the same time, to hold the door securely open, install a foot-operated holder like the one shown in Fig. 19.

Bolt does not enter striker plate: Another door defect caused by settling of the building is that the latch bolt does not enter the opening in the striker plate, but rides on the plate above or below the opening as in Fig. 22,A. Sometimes the opening in the striker plate can be enlarged sufficiently with a file as in Fig. 21 but, when the bolt misses by more than $\frac{1}{16}$ in., it is better to move the plate. First, determine the exact path of the bolt by closing the door until the latch bolt touches the projection of the striker plate. Mark the point at which the upper edge of the bolt contacts the plate, then remove the latter and mark the path of the bolt across the width. Enlarge the plate mortise accordingly and install the plate in the new position. When moving the striker plate up or down, it sometimes happens that one of the striker-plate screws will enter the mortise made for the latch bolt or dead bolt. Should this happen, drill a hole in the bottom of the mortise and glue in a short length of $\frac{1}{2}$ -in. dowel to serve as an anchor for the screw.



How to Install DORMERS

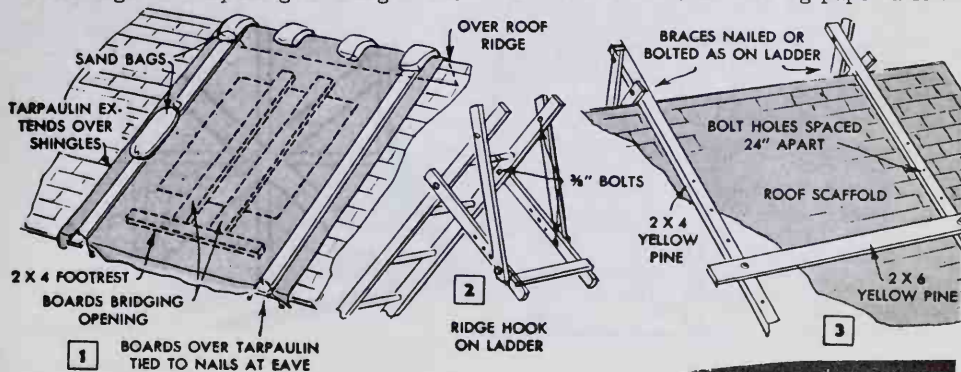
IN ADDITION to the obvious advantages of increasing usable floor space and providing adequate ventilation for upstairs rooms, dormers also improve the appearance of a house when properly designed and installed. However, location or styling of the dormers can detract from the lines of the house and, therefore, should be given careful consideration. One effective way to plan your dormers is to sketch various types and sizes of dormers on tracing paper taped over a photograph of the house. Then judge for yourself which dormer lends itself best to your installation.

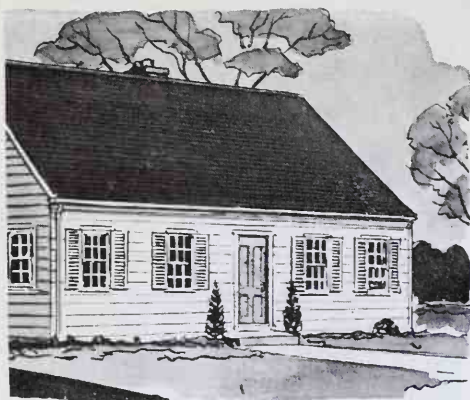
Precautions when starting: It's wise to have a large waterproof tarpaulin on hand before starting to install a dormer, so you can cover the roof opening or unfinished dormer overnight or when rain is probable. The tarpaulin should extend over shingles on either side of the opening and over the roof ridge. The opening is bridged with

boards and the tarpaulin held down by sandbags and narrow boards, as in Fig. 1.

Remove shingles first: After measuring the location of the dormer from the roof edges, remove the shingles where the opening is to be made. You can start loosening shingles from a ladder set against the eave, a ladder hooked over the ridge, Fig. 2, or from an improvised roof scaffold, as in Fig. 3. When using a ladder set against the eave, provide footrests by nailing 2 x 4 cleats to the roof as the shingles are removed.

Strips of asphalt shingle are easy to remove after prying up the nails as in Fig. 4. Use a wooden block as a fulcrum to avoid damaging the shingles. Nails in wooden shingles are cut with a flat tool having a sharp V-notch at one end. It is pushed up under shingles and struck with a hammer to sever the nails. Remove shingles a foot or so beyond the limits of the opening to be made and cut the roofing paper a few





For house expansion and for appearance, dormers are important. Here is the step-by-step procedure for opening the roof, framing, sheathing, roofing and finishing

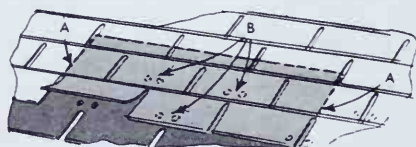
An example of what dormers can do for the appearance of a home having a large, unbroken expanse of roof. They also give light and air to attic rooms

Below, when opening up roof, shingles can be saved for use on dormer roof. Nails are lifted from roof without damaging shingles by using block as fulcrum

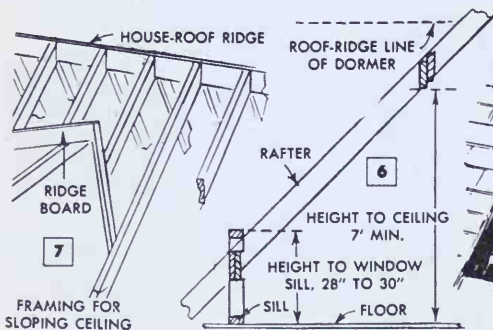
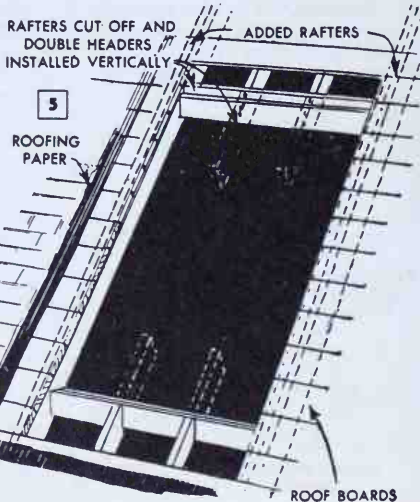
inches from the edges of the shingles, Fig. 5.

Cutting the opening: Start cutting the roof boards with a keyhole saw after boring holes to start. As soon as the kerf is long enough, use a crosscut saw. Cut closely along the rafters at each side of the opening, sawing on the side toward the opening, and remove the cut boards with a pry bar. The opening should extend the width of a roof board past the point where double headers are to be located top and bottom.

Next, cut the rafters that bridge the opening, as indicated by the dotted lines in Fig. 5. The lower edge of the upper double header should come at ceiling height as in Fig. 6. It's best to install headers on edge, marking the rafters with the aid of a level. Cut the header piece from the same size stock as rafters. Nail the rafters at the sides of the opening to one header first, then nail the header to the cutoff ends of the rafters. Install the second header piece the same



SHINGLE STRIP TO BE REMOVED. LOCATE EDGES "A," THEN PRY UP NAILS OR TWO ROWS AS AT "B"



STUDS AND
RAFTERS
SPACED
16" ON
CENTERS

DOUBLE
HEADER

8

FRAMING DETAILS OF
GABLE-TYPE DORMER

1 X 4
RIDGE BOARD

2 X 4
PLATES ON
ROOF
BOARDS

2 X 4
RAFTER
PLATE

2 X 4
FOOTRESTS

9

GAMBREL OR
DUTCH-COLONIAL
TYPE DORMER

10

WINDOW IN
WALL. TOP
PROJECTS
ABOVE EAVE

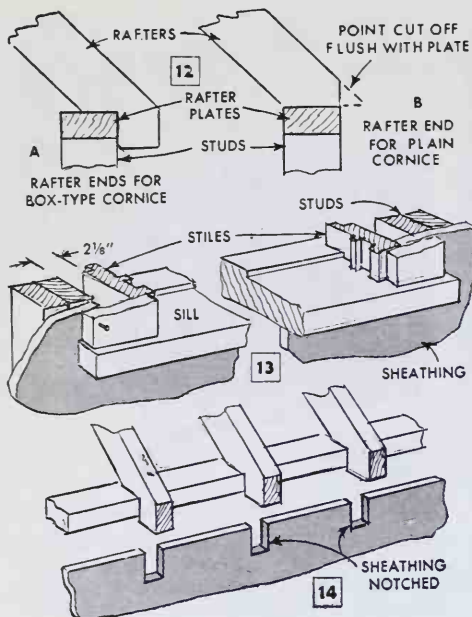
11

HIP-ROOF
DORMER

way, dropping it as necessary. The two pieces comprising the lower header should have their top edges flush, at a location where the window will come about 30 in. above the floor. If the ceiling of a dormer is to be sloping, the top header is arranged as in Fig. 7.

Wall framing: Framing of a gable-type dormer is shown in Fig. 8, and the same procedure, with only slight differences, is followed on other types shown as in Figs. 9, 10 and 11. Use 2 x 4 stock for both the wall framing and rafters, although large roof spans may require 2 x 6 rafters. First add a reinforcing rafter to each of the rafters at the sides of the opening as indicated by dotted lines, Fig. 5. These project 3 or 4 ft. beyond the double headers. Next, nail plates on the roof boards along the sides of the opening, nailing into the rafters underneath, Fig. 8. Also nail temporary footrests on the roof, which can extend over the shingles but should not be nailed through them.

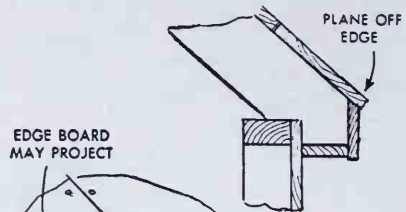
Start the wall framing by installing the double corner posts with a double header above them. Toenail the lower ends of the posts to the roof plates and temporarily brace this framework with a board from the top of the window header across to the upper roof header. The rafter plates are next. On the gable-type dormer their top edges should be at the same level as the underside of the upper header in the roof, which is ceiling height. The rafter plates are cut at an angle at one end to fit roof plates to which they are nailed. Nail the plates to the front framing while the corner posts are checked with a level to assure getting them plumb. Now, with skeleton framing in place, mark the plates for the



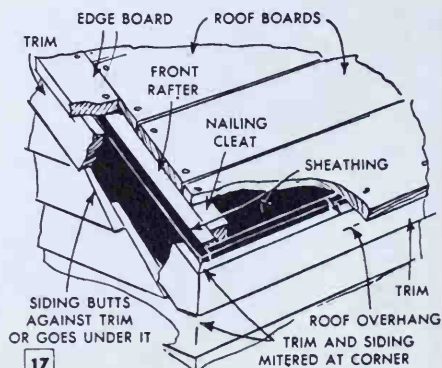
studs which are spaced 16 in. on centers. Drive nails through the top plate into the studs and toenail the studs to the roof plate.

Roof framing: Next proceed with the roof framing, starting with the 1 x 6 ridge board nailed between the roof plates at the point where they meet, in line with the center of the dormer. Support the front of the ridge board temporarily so it is level and above the exact center of the dormer. Then take careful measurements of the rafters so they can all be precut. Nail them in place after marking the ridge board and the rafter plates to locate them 16 in. on centers. If you are making a box-type cornice, the rafters are notched and extended beyond the walls, Fig. 12-A, but for plain cornices the rafters are cut off flush with the plate as in detail B. Framing the gambrel-dormer roof as in Fig. 9 is the simplest and most rigid type of construction, but requires the installation of a false ceiling. To save this extra work, the center rafters may be butted against the header and the outer rafters mounted flush with the lower edge of the header.

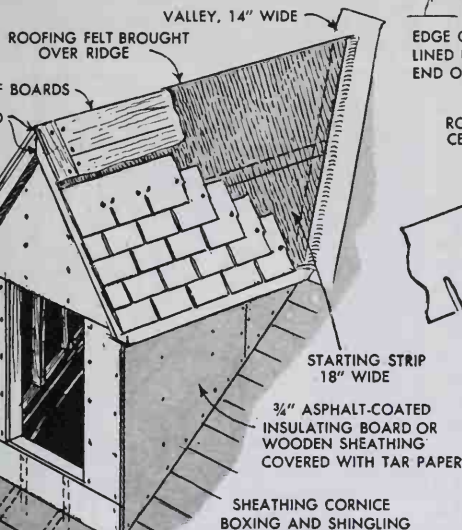
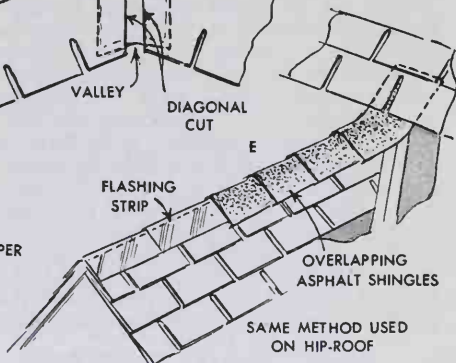
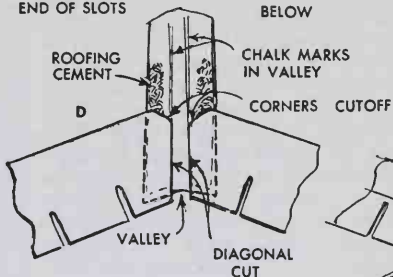
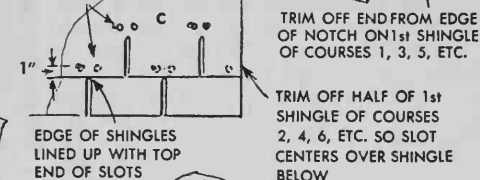
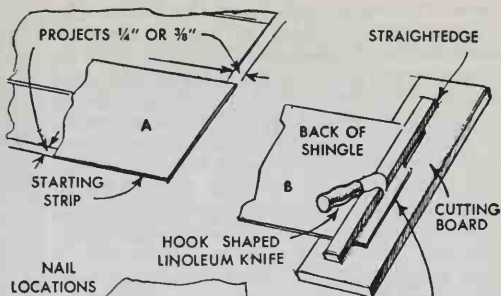
Window framing: After the sides and roof are framed, nail the ceiling joists, spacing them 16 in. on centers, and install the window framing. The window opening is centered and should be 4 1/4 in. wider than the window frame at the stiles, thus providing a 2 1/8-in. space from each stile to the frame as in Fig. 13. Usually the rough framing consists of double studs at the sides and a double header at the top. In Fig. 8 only



CORNER DETAIL OF BOX-TYPE CORNICE



CORNER DETAIL OF PLAIN CORNICE



19

single studs are shown because of their proximity to the corner posts to which they are nailed with short blocks at the center.

Sheathing: The roof is sheathed and shingled before sheathing the walls, the roof boards projecting over the edges of the siding and trim. On roofs with box cornices, apply the wall sheathing first, then add the cornice and lastly the roof. You can use wooden sheathing or composition sheathing board for the walls. The top edge of side-wall sheathing is notched, Fig. 14, to fit over the rafters, or the rafter notches may extend $\frac{3}{4}$ in. over the plate so that the sheathing can be inserted.

Cornice construction: Rafter ends for box-type cornices must be identical. Mark the rafters along their top edges using a straightedge. Mark for vertical cuts by using a level or miter gauge, and for the bottom horizontal cuts by using a square. The

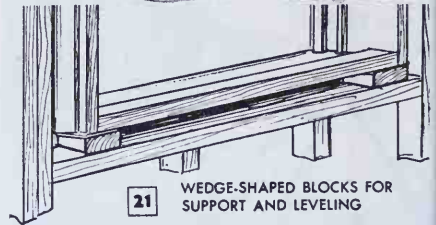
bottom board, or plancier, of the side cornice, Figs. 15 and 16, should extend at the front a distance equal to the width of the board. The side of the cornice (fascia) has its top edge beveled at an angle to fit snugly under the roof sheathing, which may project beyond it an inch or so. The side and front cornices are joined, as in Fig. 16. The edge board—also called drip edge—is nailed to the end rafter while the other roof boards butting against it are nailed to a 2 x 2 cleat nailed along the inside edge of the rafter. Dormer roof boards will fit snugly against the house roof boards if sawed at the correct angle and bevel. Construction of a plain cornice is shown in Fig. 17.

Shingling: First lay a 14-in. sheet-metal valley where dormer and house roof meet, Fig. 18, bending it with a straightedge so it lies flat on both roofs. Lay roofing felt on the roof in overlapping strips, the higher

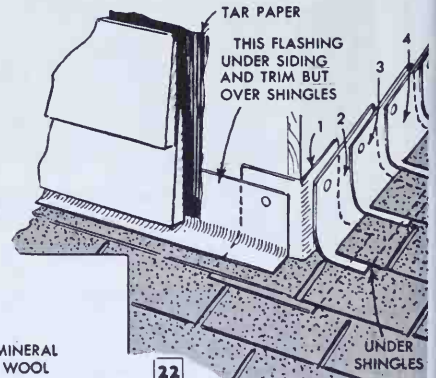
one covering 4 or 5 in. of the lower one. Then space a "starting" strip along the roof, as in Fig. 19-A, letting it project $\frac{1}{4}$ or $\frac{3}{8}$ in. Sometimes regular strip shingles are used instead of a starter strip, the shingles being placed upside down so that the slots are on top. The first shingle of the bottom course and other alternate courses is trimmed, detail B, to eliminate the half slot, or notch, at the end. Cut shingles from the back side with a linoleum knife or heavy pocketknife. Cutting is easier, especially on hot days, if you keep the knife blade moistened with kerosene. You can use the edge of a shingling hatchet or a pair of tin snips instead of a knife. Use a straightedge and cut the shingles on a board to prevent damaging them. The first shingle of the second and alternate courses is trimmed so the slot comes halfway over the shingle below, detail C. Two nails are driven about an inch above and on either side of each slot. Mark the valley by snapping a chalk line to indicate where the shingles must be cut diagonally, detail D. This detail also shows how the top corners of shingles at the valley are cut at an angle to shed water. Nails should not be driven through the sheet metal, the ends of the shingles being cemented to the valley. Shingle courses are continued to the ridge, the nails of the last course being covered with the capping, which consists of a flashing strip and individual shingles overlapped, as in detail E. The last capping shingle is brought upward and under a shingle course of the house roof. When wooden shingles are used, courses overlap to expose about 5 in. to the weather. The shingles are spaced $\frac{1}{4}$ to $\frac{3}{8}$ in. apart. Keep the side edges of the shingles at least $1\frac{1}{4}$ in. from the edges of shingles in the course below. Drive the shingle nails



20

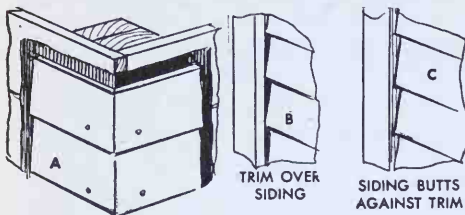


21 WEDGE-SHAPED BLOCKS FOR SUPPORT AND LEVELING



22

FLASHING AT JOINTS OF DORMER AND HOUSE ROOF



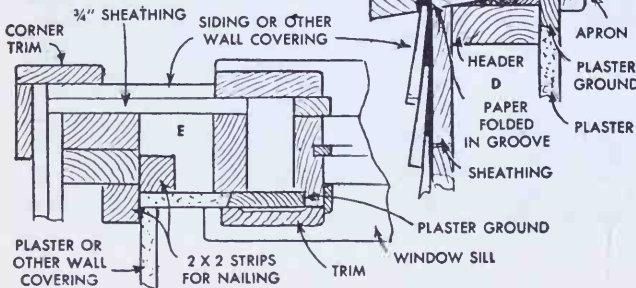
CORNERS MITERED FOR TIGHT FIT. NAILS COUNTER-SUNK AND PUTTIED

24

TRIM OVER SIDING

SIDING BUTTS AGAINST TRIM

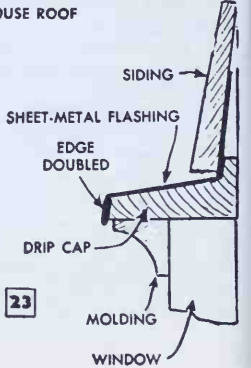
SILL



PLASTER OR OTHER WALL COVERING

2 X 2 STRIPS FOR NAILING

WINDOW SILL



23

WINDOW



about 6 in. above butt ends of the shingles and not closer than $\frac{3}{4}$ in. from the edges.

Installing window frames: Set the window frame in the opening so that the stiles are $2\frac{1}{2}$ in. from studs, Fig. 13. Drive wooden wedges between the sill and the header as shown in Figs. 21 and 24-D to get the frame plumb and hold it securely in position while nailing the outer trim. Before nailing, check the window frame with a level, as in Fig. 20.

Flashing to prevent leaks: After resheathing the house roof to the front of the dormer, add a sheet-metal flashing strip along the dormer. The strip should be at least 8 in. wide and bent centrally to come over the shingle nails, as in Fig. 22. Fasten the upper edge to wooden sheathing or to studs under insulating-type sheathing. Also apply a flashing strip over the drip cap at the top of the window, as in Fig. 23. Use "metal shingles" where the dormer sides join the house roof, Fig. 22, starting at the front corners. Note that flashing piece No. 1 is applied before the front flashing strip and

NAILS TO USE

- 20d COMMON NAILS: Rafters to double headers and vice versa; roof plates to rafters underneath
- 16d COMMON NAILS: Rafter plates to ends of studs
- 10d COMMON NAILS: Reinforcing rafters or any double studs fastened together; toenailing studs, rafters, joists, etc.
- 8d COMMON NAILS: Wooden wall and roof sheathing, outside trim (countersunk and puttied)
- 8d ALUMINUM NAILS: Siding and exterior trim
- 8d FINISHING NAILS: For interior trim
- $1\frac{1}{4}$ " LARGE, FLAT-HEAD, GALV. NAILS: For insulation-type sheathing
- $\frac{7}{8}$ " or 1" WIDE, FLAT-HEAD, GALV. NAILS: Asphalt shingles on roofing boards
- 3d GALV. SHINGLE NAILS: For wood shingles

is bent around the corner. Bring the roof shingling over flashing piece No. 1, which should lie flat on the roof about 4 in. beyond the dormer. Flashing piece No. 2 overlaps No. 1 and is similarly covered with the next shingle course. The same procedure is followed for pieces 3 and 4.

Application of siding: Outside wall covering should match that of the house or harmonize with its styling. If wooden sheathing is used, it is covered with tar paper before applying siding, clapboard or shingles. Siding at outside corners can be neatly mitered, Fig. 24-A, with the joining edges embedded in calking compound. Siding may be covered with trim, detail B, and spaces between the siding and trim tamped with mineral wool and calked. Another method is to butt the siding against the trim, detail C, the lower edge of the siding being kept about $\frac{1}{2}$ in. above the roof to prevent absorption of water. It's best to use aluminum nails as they need not be countersunk and puttied to prevent rust spots. Siding under a window fits into the groove on the underside of the sill, detail D, and is pushed up tightly against a folded edge of the sheathing paper.

Finishing the inside: It's advisable to insulate walls and ceiling of a dormer, using a vapor-barrier insulation. Fig. 25 shows batt-type insulation being installed. When insulating, stuff mineral wool between the window sill and the header, Fig. 24-D. The inside wall may be finished with wallboard or plasterboard. If the wall is to be plastered, apply plaster grounds along all edges of the window, details D and E of Fig. 24, and along the floor edge of walls. These grounds come flush with the plaster. Apply perforated-metal corner beads at outside corners before plastering, and strips of metal lath along inside corners.

After plastering, install trim around the windows. A plywood subfloor is installed, over which any type of finish floor may be laid. Baseboards are applied after laying the finish floor. Fig. 26 shows an inside view of the finished dormer.

★ ★ ★

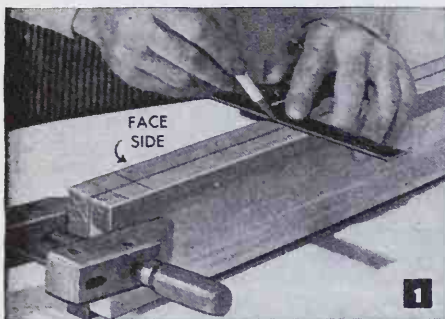
DOWEL JOINTS

FOR MOST types of joinery, a good dowel joint is adequate. It can be made quickly and compares favorably in strength with mortise-and-tenon joints. It's the ideal joint for toys and light furniture construction.

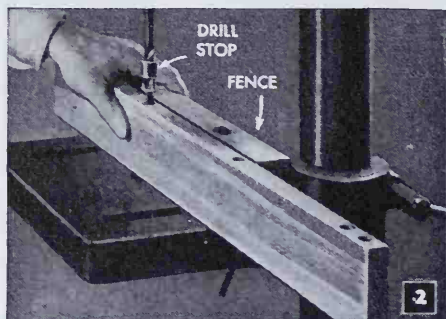
Edge joints: Joining boards edge to edge is a common application of the dowel joint. The preferred method of working calls for clamping the boards together, face sides out, as in Fig. 1, and ruling crosslines to indicate the dowel position. A spacing of 8 to 10 in. between dowels is recommended, with two dowels at each end, Fig. 3. All drilling of holes is done with the face side of the work against a fence mounted on the drill-press table, as shown in Fig. 2. This automatically sets the crosswise spacing

and makes all dowel holes a uniform distance from the face surface. The fence itself should be short and of sufficient thickness to assure accurate alignment parallel with the drill.

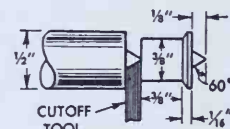
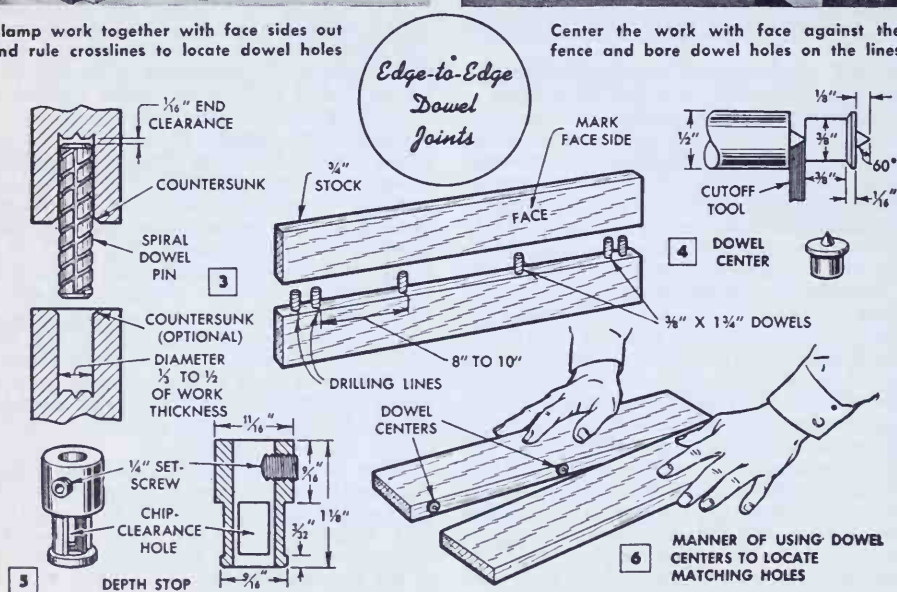
In a second method of working, no pencil guide marks are used, and the work is simply held against the fence while the holes are spaced by eye. Dowel centers, or pops, are inserted in the holes, and then, by contacting the two boards face downward, Fig. 6, registering marks are transferred to the second board. Dowel centers can be purchased, or they can be turned from cold-rolled steel to the shape shown in Fig. 4. If drilling is done by hand, both methods described require a stop on the drill bit to set the depth. This can be



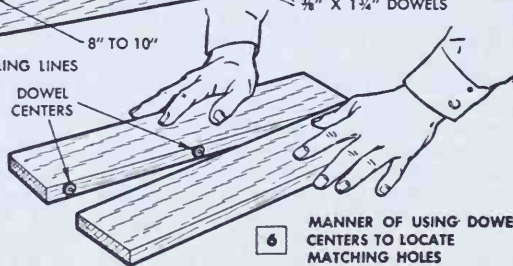
Clamp work together with face sides out and rule crosslines to locate dowel holes



Center the work with face against the fence and bore dowel holes on the lines



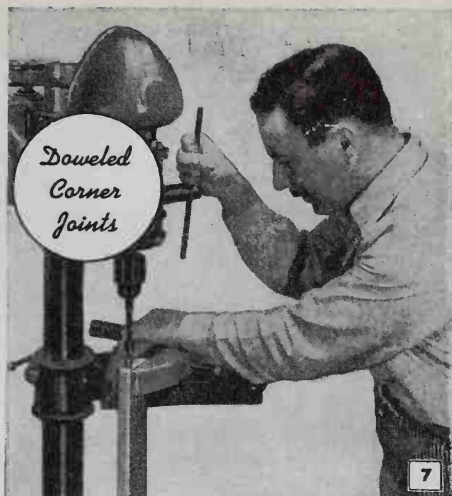
4 DOWEL CENTER



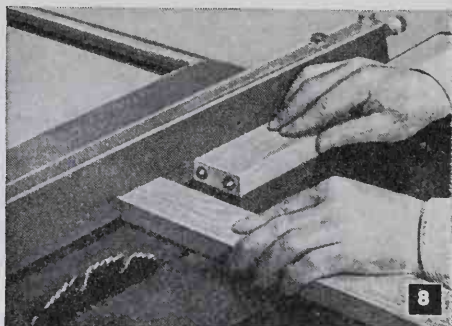
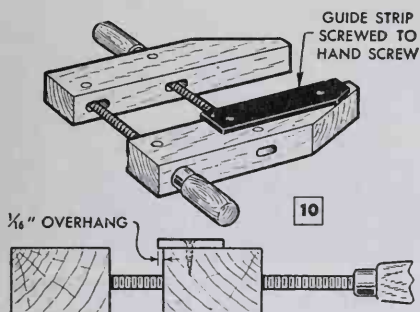
6 MANNER OF USING DOWEL CENTERS TO LOCATE MATCHING HOLES

made as shown in Fig. 5, or a short dowel can be drilled lengthwise and slipped over the bit. As most joints are made with $\frac{3}{8}$ -in. dowels, one size of stop will do. Occasional work requiring smaller or larger dowels can be drilled for depth by fastening adhesive tape around the bit.

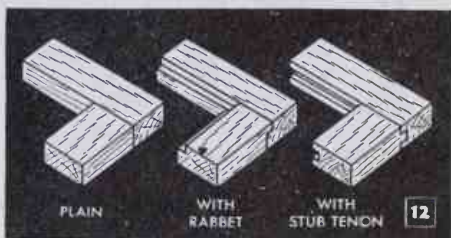
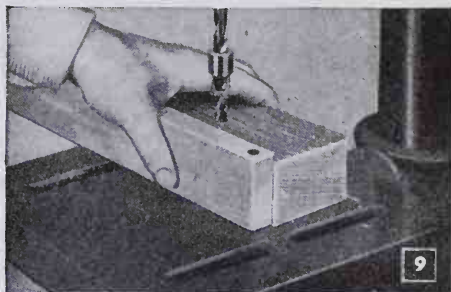
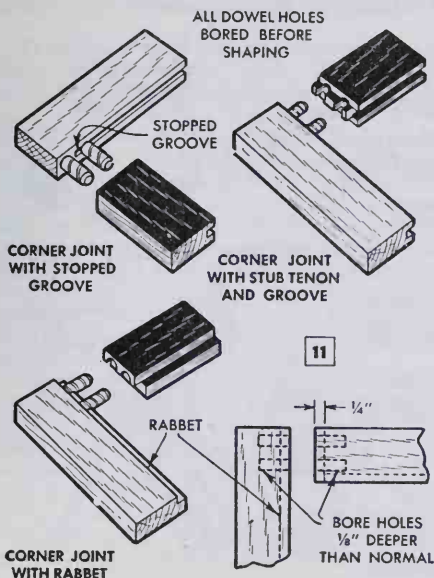
Corner joints: This is the most used dowel joint. The best method of making it is to drill the end-grain holes first, Fig. 7, spacing them by eye, and then use dowel centers for locating the side holes in the second piece, as shown in Fig. 8. A fixed fence is not used for drilling the side holes, but it is advisable to use a backing block or floating fence, Fig. 9, to keep the work square with the table. The difficult part about this joint is drilling the holes in the

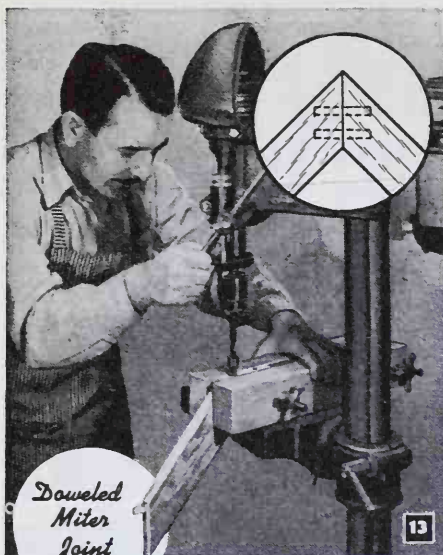


Bore holes in end grain first, spacing them by eye



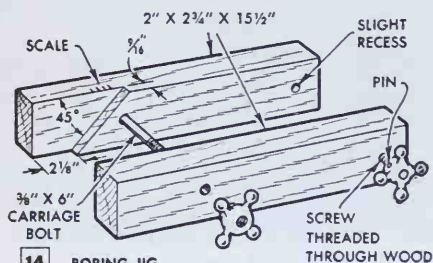
Above, locate position of side holes with dowel centers. Below, drill side holes with work against block





Doweled Miter Joint

Doweled miter joints are easy to make with boring jig below



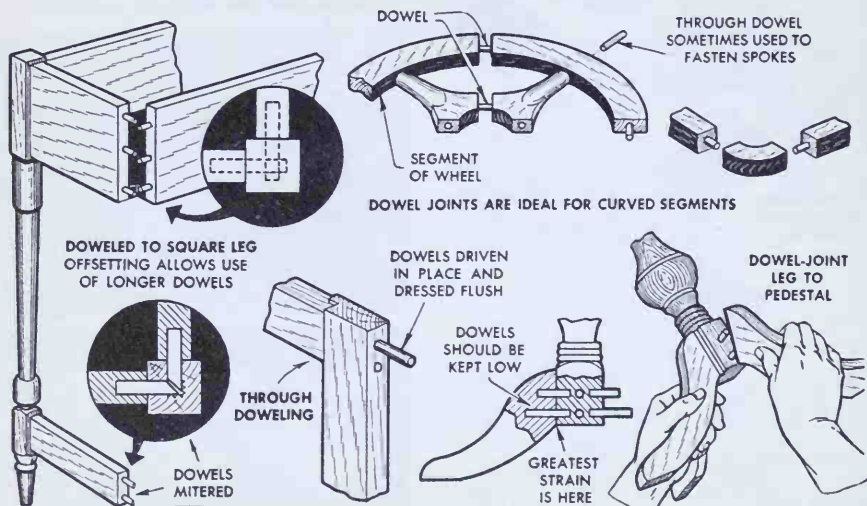
14 BORING JIG

end grain of the first piece. However, this is made easy with a handscrew fitted with a stop, as shown in Figs. 7 and 10. In use, the work is aligned with the bit by clamping it in the handscrew so that the end butts squarely against the stop attached to the jaw. Then the table is swung to one side to support the handscrew. Note that the table must be at right angles to the bit.

Various forms of the corner joint are shown in Figs. 11 and 12. Where the work is to be grooved or rabbeted, dowel holes should be drilled first. The stub tenon and rabbeted frames, Fig. 11, will lose $\frac{1}{4}$ in. at the joint when shaped, and this should be allowed for. Make rails $\frac{1}{2}$ in. longer than normal, and drill dowel holes $\frac{1}{8}$ in. deeper.

Doweled miter joint: Dowel holes are always bored at right angles to the contacting surfaces which are to be joined. This is fairly obvious in the 45-deg. miter joint, Fig. 13. Working with the handscrew setup, or with the somewhat similar boring jig shown in Fig. 14, the contacting surface of any joint is presented squarely to the drill. The method of making a miter joint is the same as a corner joint—eyeball the first piece and then use dowel centers to locate holes in the second piece.

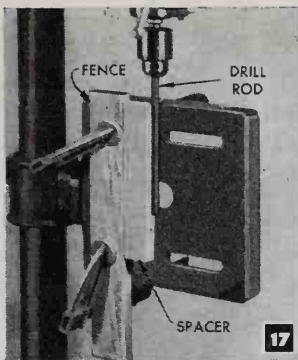
Various applications: While there are many uses for the dowel joint, all dowel joinery follows the same pattern, that is, two butting surfaces joined together with dowel pins. Typical work is shown in Fig. 15. For all occasional work, the dowel-center method of locating holes is used, and holes in end grain are drilled first, because it is difficult to mark accurately and spot a drill on this kind of surface.



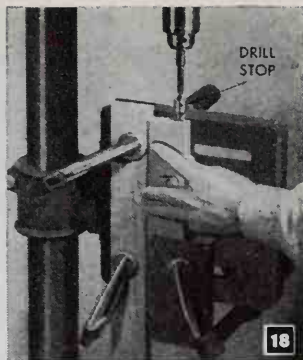
15 APPLICATIONS OF THE DOWELED JOINT



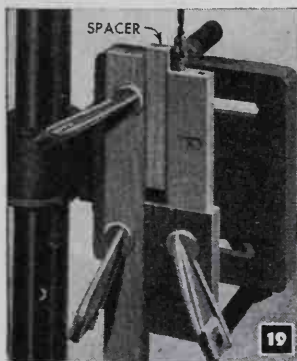
First, make rough assembly of frame, mark face side and outer edge of all members with pencil



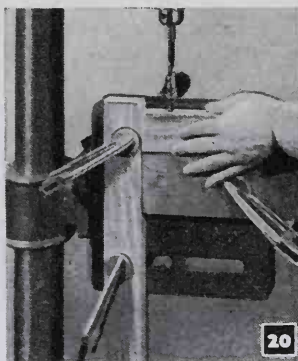
Next, with drill-press table tilted vertically, insert drill rod in chuck and align fence with rod



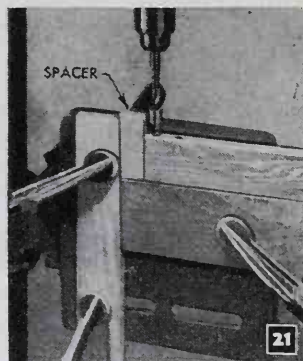
Drill the end holes in all rails first, placing the marked edges against a fence clamped to table



Drill second hole in end of rails by using same setup plus wooden block to space holes desired width



With work positioned by vertical fence plus horizontal rest, drill first end holes in stiles of frame



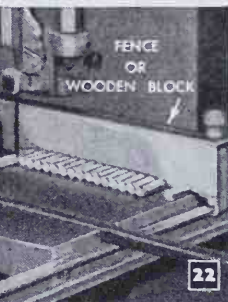
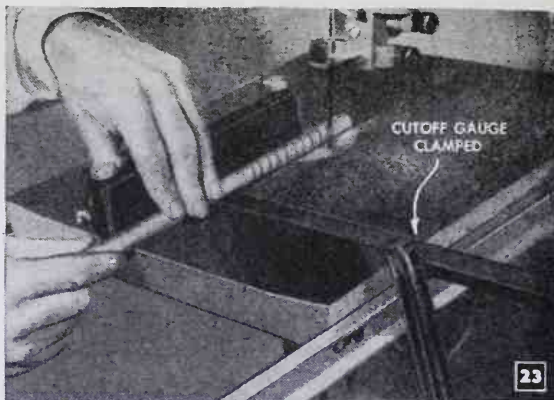
As in drilling second dowel hole in ends of rails, repeat same operation, using short spacer block

Production work: Dowel centers are too slow for production work, and various methods employing box jigs or spacers give better results. The schedule for a doweled frame is pictured in Figs. 16 to 21 inclusive. In this setup, one stop is clamped to the drill-press table, and this stop is used for both parts of the joint, giving perfect accuracy in the lengthwise spacing. As each joint consists of a right and left-hand member, the face side will alternately face toward and away from the fence. This makes it essential that, (1) the work be of uniform thickness, and (2) the drill must be exactly centered crosswise.

The dowel drill: The best type of drill for dowel work is the popular twist-drill pattern with spurs and brad point. The point should run true so that when rotating, it will seem to stand still and can be centered with hairline accuracy. Drill speed should be 1200 r.p.m. for hardwoods and 2400 r.p.m. for softwoods. Extension spurs on the drill should be short and

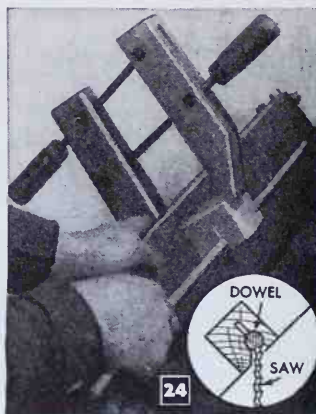
sharp to eliminate leading or wandering tendency when drilling end grain.

The dowel pin: The dowel pin itself is usually birch or maple and is purchased ready made. Specify a spiral, grooved pattern, which has the best holding power. The diameter of the pin should be one third to one half the thickness of the work—never less than one third. As a large percentage of all work is $\frac{3}{4}$ -in. stock, the $\frac{3}{8}$ -in. dowel is the size most used. The length should be five or six diameters for average work. Thus, a $\frac{3}{8}$ -in. dowel should be $1\frac{3}{4}$ or 2 in. long, and either of these stock sizes can be used for most jobs. When smaller or larger diameters are needed in small quantities, the dowel pins can be made from standard dowel rod. Cutting-off to length is done on the bandsaw, Fig. 22. If a spiral groove is desired, it can be cut very neatly by tilting the bandsaw table 15 or 20 deg., and then pushing the rod into the blade against a clamped fence, as shown in Fig. 23. The dowel rod will feed



Dowel Pins

Dowel pins may be purchased, but odd sizes can be turned in short lengths on lathe. The photos show way of mass-cutting pins to length and spiraling in bandsaw. The glue groove, running lengthwise, is produced on bench saw

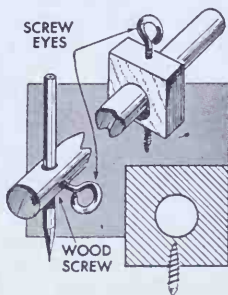


itself and requires only a slight hold-back hand pressure to prevent over-running. While the spiral groove is not essential, some kind of grooving should always be used to provide an outlet for excess glue. The straight groove is easily run with the saw setup shown in Fig. 24.

Gluing: Any cabinet glue, hot or cold, is satisfactory for doweled joints. A small dowel is used to put glue into the hole, and the dowel itself is dipped half its length

into the glue. If the joint is not to be assembled immediately, any excess glue should be wiped off. If the joint is to be assembled immediately, the small dowel stick is used to spread glue in the second hole and over the projecting part of the dowel. Then, the joint is pressed together and clamped. Slight countersinking of dowel holes, as shown to the left of Fig. 3, is a good idea and is intended to provide a recess for excess glue.

Home-workshop owners who have only occasional use for a beam compass can improvise one from a length of dowel as pictured. One end is drilled to take a lead pencil, which is held in place by means of a screw eye. The movable pivot for the com-



Beam Compass Improvised From Dowel Rod

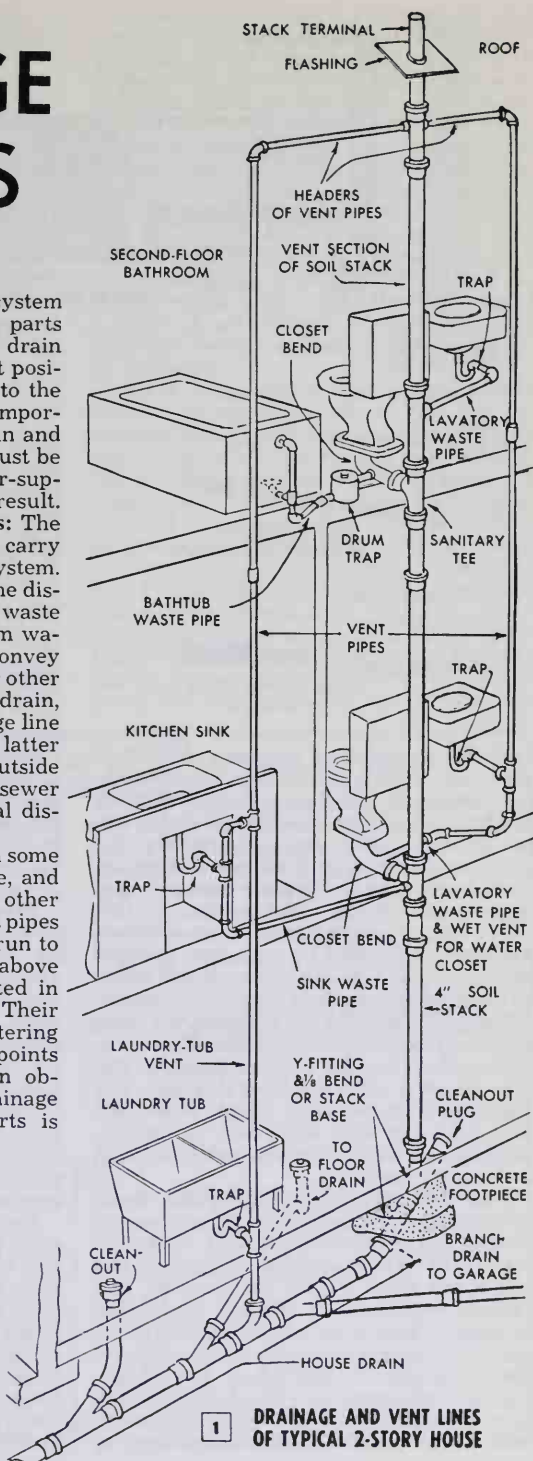
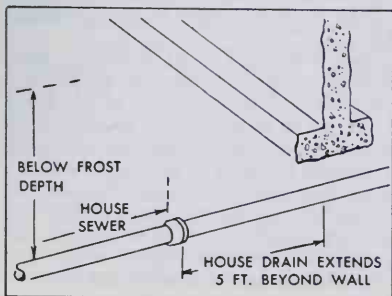
pass is made from a small block of hardwood which is drilled to slide over the dowel. A wood screw driven into the underside of the block and filed to a point serves as the pivot, and a screw eye driven into the upper end locks the block into position on the dowel.

DRAINAGE SYSTEMS

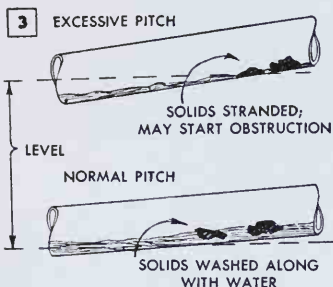
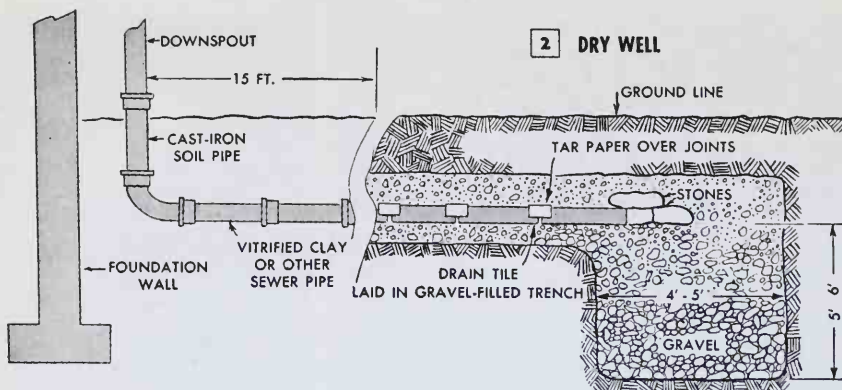
WHEN A COMPLETE home-plumbing system is installed, you start with the basic parts of the drainage system—the house drain and the soil stack—because the exact positioning of the stack and its relation to the spacing of the fixtures is of utmost importance. After installing the house drain and soil stack, the waste and vent lines must be coordinated carefully with the water-supply lines so that no interference will result.

What the drainage system includes: The drainage system consists of pipes that carry waste, and others that ventilate the system. Those carrying liquid waste but not the discharge from water closets are called waste pipes. Those carrying discharges from water closets are called soil pipes. Both convey their contents to the main soil stack or other stack, and these connect to the house drain, which is the lowest horizontal drainage line and connects to the house sewer. The latter starts at a point not less than 5 ft. outside of the house wall and leads to the city sewer or to the septic tank of an individual disposal system.

Stacks terminate above the roof. On some the lower portions serve for drainage, and the upper portion for ventilation; other stacks serve for ventilation only. Vent pipes which connect to drainage pipes are run to stacks by means of headers, at points above the highest fixtures. Traps are located in waste and soil lines near fixtures. Their purpose is to keep sewer gas from entering a building. Cleanout plugs at various points permit rodding drainage lines when obstructions occur. A typical home-drainage system comprising all of these parts is shown in Fig. 1.



1 DRAINAGE AND VENT LINES OF TYPICAL 2-STORY HOUSE



Kinds of drainage systems: A system used only to convey drainage from plumbing fixtures is called a sanitary system. A combination system also admits storm water. In many cities separate sanitary and storm-water drainage systems are required, each leading to a separate sanitary and storm-water sewer. The reason is that storm water in sewage is not desired where the latter is handled by a modern sewage-treatment plant. Storm water should never be emptied into a septic tank of an individual disposal system as it floods the tank and interferes with its operation. Storm water may lead to a dry well, as shown in Fig. 2, or to some other point of disposal. The discharge of storm water should be at least 50 ft. from any well, 20 ft. from an individual disposal field of sewage and at least 15 ft. from the house.

Pipe and fittings for drainage lines: Check with your local code concerning the kind of piping permitted for soil, waste and vent lines. Above-ground piping for soil and waste lines should be cast-iron, galvanized wrought iron or steel, lead, brass or copper. Vent pipes may be of these materials but asbestos-cement or bituminized-fiber pipe can be used often. For underground lines inside of a building, cast-iron pipe of the hub-and-spigot type is generally used, although galvanized wrought-iron or

steel, lead and copper pipe may be permitted also. Where threaded joints are approved for underground use, they should be coated with asphalt enamel and wrapped with a suitable waterproof material. Storm drains and house sewers may be cast iron, copper, vitrified clay, concrete, bituminized fiber or asbestos cement.

Threaded fittings should be of the recessed drainage type, although ordinary cast-iron fittings may be used on vent pipes. Long-radius fittings are used in drainage lines wherever possible to make gradual changes of direction, particularly in horizontal lines. Any fitting that has an enlargement, chamber or recess with a ledge, shoulder or reduction of pipe area, which can obstruct the drainage flow, should not be used in any drainage line. Increases in vent stacks and 4 by 3-in. closet bends are not considered restrictive fittings.

Pipe slope or pitch: In drainage lines the flow of liquid is entirely dependent on gravity. For this reason horizontal sections of drainage lines must be given a uniform slope or pitch, which may vary from $\frac{1}{8}$ to $\frac{1}{2}$ in. per ft., depending on the pipe size and conditions encountered. The pipe must not have any dips or pockets from which sewage cannot drain out completely. Threaded fittings that connect horizontal pipes to vertical ones have their horizontal openings pitched at the usual slope of $\frac{1}{4}$ in. per ft. Care must be taken to install them correctly.

For pipes 3 in. or less in diameter, the slope should not be less than $\frac{1}{4}$ in. per ft. For larger sizes of pipe a slope of not less than $\frac{1}{8}$ in. per ft. is sometimes used. However, where conditions necessitate a lesser slope, it should be such as to assure a flow of not less than 2 ft. per second. Excessive slope in horizontal pipes, particularly in large-size pipes, allows solids to remain in the pipe while the water drains away, as in Fig. 3. When a house drain must be in-

stalled above a basement floor, water from the laundry tubs and basement floor drains is pumped up to it with a sump pump.

Importance of correct pipe sizes: For minimum cost as well as efficiency, use the smallest pipe sizes that will adequately carry away sewage. Installing a house drain larger than required does not increase its efficiency as may be supposed, because the flushing action of the water is greatly decreased in a large pipe, leaving solids stranded. See Fig. 3. However, if the pipe is too small it will be overloaded, which may occasion troubles such as basement flooding and back pressure in the drain-age pipes.

Basis for finding pipe sizes: The fixture-unit system is used to determine pipe sizes for both drainage and vent lines. The basic unit is 7½ gal. per minute flow (approximately 1 cu. ft.), this being the amount of water discharged from the average type lavatory. Multiples of this unit are used to express the discharge rate of various fixtures as given in Fig. 4, which also gives the minimum sizes of traps for these fixtures. Table B gives fixture-unit discharge of various sizes of pipe openings, and is used for tanks and for fixtures not listed in table A.

Sizing house drain and sewer: To find the size of a sanitary house drain and sewer,

you add up the fixture units to get the total load and then refer to table C of Fig. 4. For example, if the total load of a system is found to be 30 fixture-units, reference to the table will show this value to lie between 27 and 216 in the column for ¼-in. slope, which is most generally used. Using the higher value, the proper size pipe would be 4 in. This method is similarly followed for branch lines. Generally the house drain and main stack are the same size. A 3-in. size for these is generally adequate for most small homes. A pipe smaller than 3 in. should not be used to take the discharge of a water closet. No portion of underground drainage branches should be less than 2 in. in diameter.

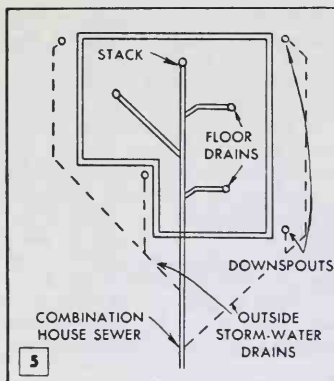
Sizing combination and storm-water drains: Where storm water can be discharged into a combination house drain or sewer, you allow one fixture unit for each 180 sq. ft. of roof area discharged into the house sewer. This value is based on rainfall rate of 4 in. per hour. The total roof load is added to the fixture-unit load. Arrangement of an outside storm drain is shown in Fig. 5. It should run in the same horizontal plane as the combination drain or sewer and be connected to it with a single Y-fitting at least 10 ft. downstream from any branch to the house drain or from any soil stack. To determine the size of pipe re-

A	DISCHARGE RATES OF FIXTURES IN FIXTURE UNITS		
	Type of Fixture	Fixture-Unit Value	Minimum Size of Trap (In.)
One bathroom group consisting of water closet, lavatory and bathtub or shower stall			
	for tank-flushed closet	6	
	for flush-valve closet	8	
Shower stall			
Bathtub (with or without shower head)			
Lavatory		2-3*	1½ - 2
Kitchen sink		1-2*	1¼ - 1½
Kitchen sink with disposal unit		2	1½
Dishwasher		3	1½
Combination sink and laundry tub		2	1½
Combination sink and laundry tub with disposal unit		3	1½
Laundry tub (1 or 2 compartments)		2	1½
Water closet—tank-flushed		4	3
Water closet—flush-valve type		8	3
Floor drain†		1	2
* Depends on size of outlet; see table B			
† Size determined by area of drainage			

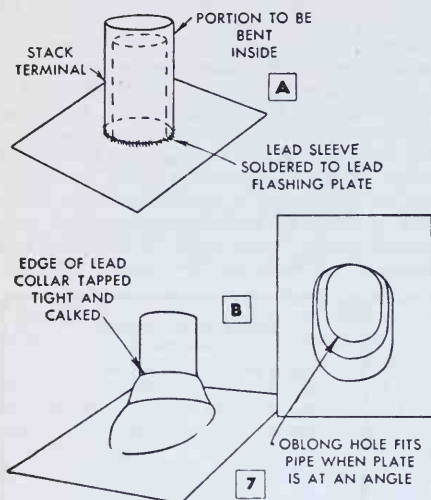
B	FIXTURE UNITS AS RELATED TO DRAIN SIZE	
	Size of Drain or Trap (In.)	Fixture-Unit Value
	1¼ or smaller	1
	1½	2
	2	3
	2½	4
	3	5
	4	6
Note: For a continuous or semicontinuous flow into drainage system, as from a pump, add two fixture units for each gallon per minute of flow		

C	MAXIMUM FIXTURE-UNIT LOADS FOR HOUSE DRAINS AND SEWERS, INCLUDING BRANCHES			
	Pipe Dia.	⅛" Slope	¼" Slope	½" Slope
	2"	21	26	
	2½"	24	31	
	3"	20	27	36
	4"	180	216	250
	5"	390	480	575
	6"	700	840	1000
*Not more than two water closets				

D	MAXIMUM FIXTURE-UNIT LOADS FOR STACK AND HORIZONTAL BRANCHES		
	Pipe Dia.	Any Horizontal Branch	When Connected to One Stack Not Over 3 Stories High
	1¼"	1	2
	1½"	3	4
	2"	6	10
	2½"	12	20
	3"	20	30
	4"	160	240
	5"	360	540
	6"	620	960
* Not more than two water closets			



6 SIZE OF HORIZONTAL STORM DRAINS				
Diameter (In.)	Roof Area for Drains at Various Slopes			
	Slope in Inch Fractions per Running Foot			
	$\frac{1}{8}$ " Slope	$\frac{1}{4}$ " Slope	$\frac{1}{2}$ " Slope	$\frac{3}{4}$ " Slope
3		822	1160	1644
4		1880	2650	3760
5		3340	4720	6680
6		5350	7550	10,700
Size of Gutters				
3	170	240	340	480
4	360	510	720	1020
5	625	880	1250	1770
6	960	1360	1920	2770
Size of Downspouts				
2	720			
2½	1300			
3	2200			
4	4600			



quired for storm drains, gutters and downspouts, refer to the table, Fig. 6.

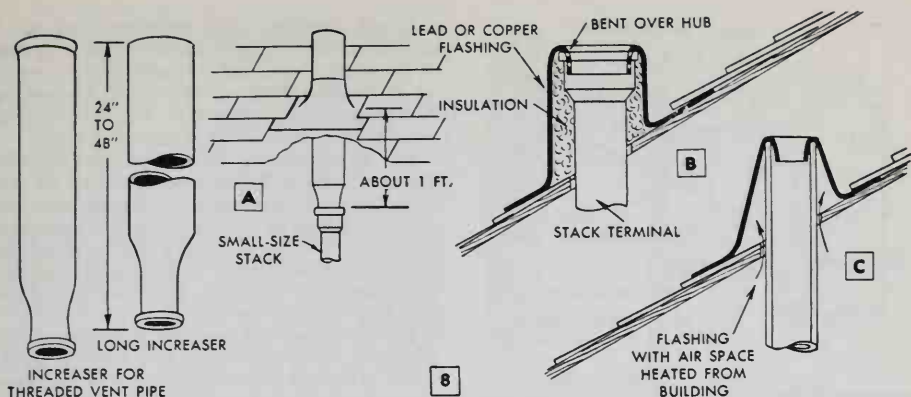
The soil stack: A soil stack is run up inside of the house generally, being concealed in partitions if possible. It should be centrally located so that the drainage and vent lines serving various fixtures will be of minimum length. It is not advisable to place a stack in an outside wall in climates where temperatures drop to freezing and below, unless the pipe is sufficiently insulated. For the same reason, and also because of appearance, a stack is usually not located outside of a building. In mild climates, however, this can be done to minimize cost, and the stack then can be boxed in for concealment. A soil or waste stack should not be smaller than the largest horizontal branch connected to it, although a 4 by 3-in. water-closet bend is not considered a reduction in pipe size. To determine

the proper size of the stack consult table D, Fig. 4.

Stack and vent terminals: A stack passing through a roof should project no less than 6 in. above it. Leakage at the roof is prevented with lead or copper flashing as in details A and B of Fig. 7. Detail A shows vent flashing made by soldering a lead sleeve over a hole cut in a sheet of lead. The angle between the sleeve and sheet should correspond to the roof pitch. The extending end is bent down inside of the pipe. Detail B shows a formed flashing which has an oblong hole so that the flashing can be set at various angles, after which the collar is tapped to a snug fit against the pipe. Shingles go over a flashing sheet at its highest portion, but go under it at the lowest portion.

Provisions must be made to prevent the moisture inside of the stack terminal from freezing and possibly clogging it. This trouble is less likely on 6-in. extensions than on longer ones. Where possibility of such frost closure exists, the terminal should be at least 3 in. in diameter, though 4 in. is preferable. Small vent stacks should be enlarged by means of increasers such as shown in Fig. 8A. They are joined to the stack a foot or so below the roof. Another precaution against frost closure is insulation between the pipe and the flashing as in detail B, or by providing an air space which is heated from the building as in detail C.

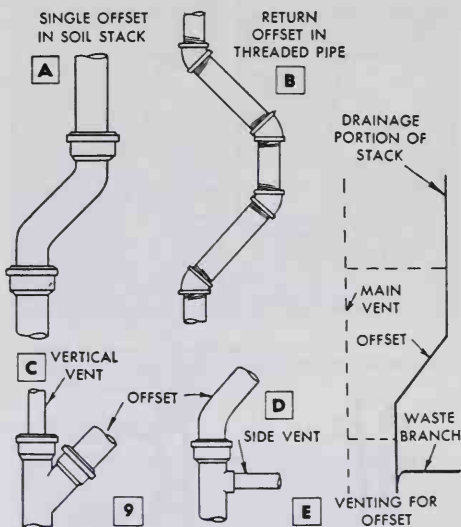
The terminal of a stack or vent pipe should not extend directly beneath a door, window or other ventilating openings of a building. If within 10 ft. of such an opening, the vent should project at least 2 ft. above it. When a vent terminal is extended horizontally through a wall, where permitted, it should be at least 10 ft. from the lot line and the opening should face downward. A vent should never terminate under the overhang of a roof or under any other part of a building.



Offsets in stacks: Sometimes a stack, located advantageously in relation to the fixtures it serves, cannot be run up in a vertical line as is most desirable, owing to building construction or other interference. In such cases it is necessary to go around the obstruction with an offset. A single offset, as in Fig. 9A, introduces less resistance than a return or jumpover offset as shown in detail B. An offset in the drainage portion of a stack, which is 45 deg. or less from the vertical, is sized as a straight stack, but in case a horizontal branch connects within 2 ft. above or below the offset, a relief vent is installed. This may be either a vertical continuation of the lower portion of the stack, detail C, or it may be a side vent connected between the offset and the next lower horizontal branch. See detail D. In either case a vent is also provided above the offset as in detail E.

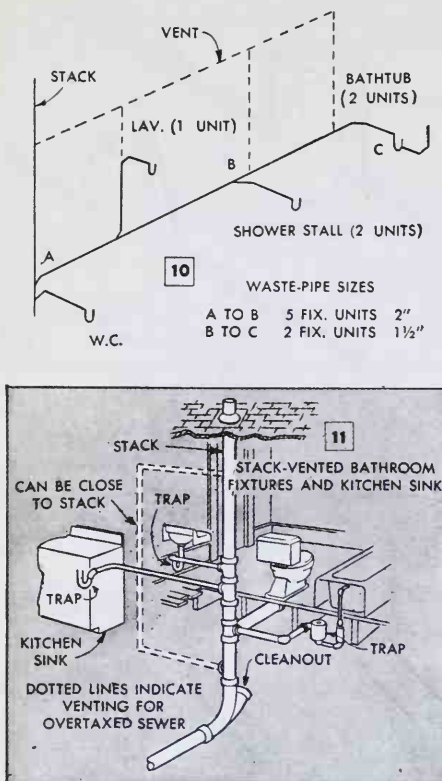
The size of the vents should not be smaller than the main vent or half as large as the stack. If an offset is below the lowest horizontal branch and is greater than 45 deg. from the vertical, its size is determined as for a building drain. A horizontal branch should not connect to a stack within 2 ft. of an offset that is greater than 45 deg. from the vertical. These restrictions do not apply to offsets in the vent portion of a stack.

Horizontal drainage branches: A drainage extension to a water closet should be as short as possible and not less than 3 in. in diameter. A cast-iron water-closet bend may be plain or may have tapped openings for connecting waste pipes from fixtures. The size of a waste pipe from an individual fixture is the same as the minimum trap size for the fixture, as given in table A of Fig. 4. Waste pipes serving more than one fixture must be sized according to their fixture-unit load, referring to table D of Fig. 4. An example of sizing horizontal

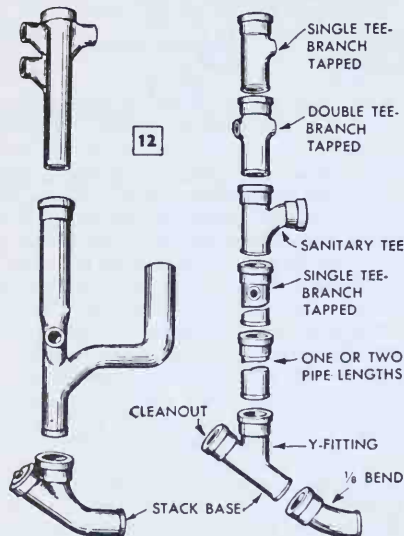


waste pipes of a bathroom group is shown in Fig. 10. Sometimes larger sizes are used for waste pipes serving one or more fixtures, as for instance when the waste pipe is vented from a stack located too far from the fixture to use the normal size. See "Stack venting" discussion that follows.

Purposes of vent pipes: In every plumbing installation the drainage system requires vent pipes for three purposes: (1) To prevent the water seal in fixture traps from being sucked down into the drain pipe either by siphon action or by the momentum of the discharge flow; (2) To prevent back pressure, particularly at lower levels, from forcing water out of traps through the fixtures and (3) to carry away sewer gases to the outside of the house.



CONVENTIONAL PLUMBER'S "TREE" WITH 7 OR 8 PARTS FOR SAME CONNECTIONS
THREE PREFABRICATED PARTS



Stack venting: The simplest and most economical venting installation for a group of fixtures often used in single-story houses or at the top floor of two-story houses, is "stack-venting," shown in Fig. 11. This is applicable for the following conditions:

(1) The distance from the stack to the fixture traps is limited as specified in the table, Fig. 14. If a fixture is located too far from the stack to vent it through waste pipe of a size based on fixture units, a larger diameter waste pipe that meets the requirements of distance, as given in the table, Fig. 14, can be used.

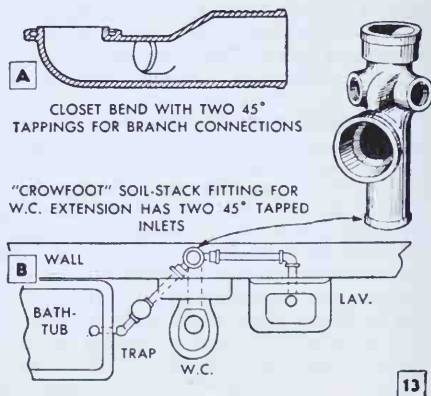
(2) No other water closet or bathtub can discharge into the stack at a higher level.

(3) The total discharge of the fixtures above the water closet and bathtub connections to the stack must not exceed three fixture units.

(4) Each of the fixtures must discharge into the stack independently of others.

When a sink connects to a stack-vented bathroom group at a location where the street sewer occasionally becomes overloaded and floods the house sewer, a relief vent should be connected to the stack below the stack-vented water closet or bathtub, as shown by the dotted lines in Fig. 11.

Prefabricated stack-venting units: Time and money can be saved by using prefabricated drainage units designed for stack venting where their use is permitted by local code. These units are neat and compact and can serve the drainage requirements of kitchen sink, laundry tub and even a bathroom group of fixtures in a one-story house. All of them, of course, should be located close to the stack according to requirements. Various arrangements of fixtures are possible. Fig. 12 shows three prefabricated units that replace seven or eight ordinary pipe lengths and fittings of the usual plumber's "tree," used for the same purpose. The vent portion of the stack in



MAXIMUM DISTANCE OF FIXTURE TRAP FROM VENT

Size of Fixture Drain	Distance in Feet
1 1/4"	2 1/2
1 1/2"	3 1/2
2"	5
3"	6
4"	10

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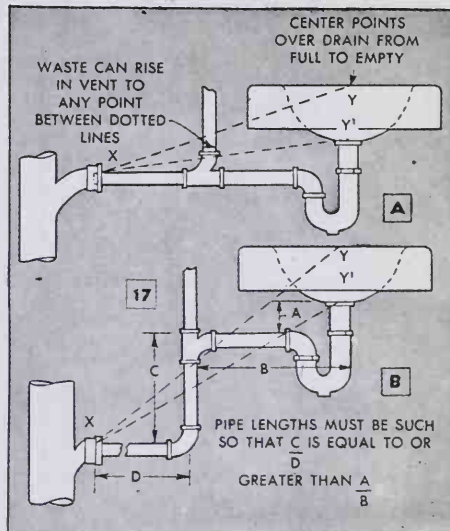
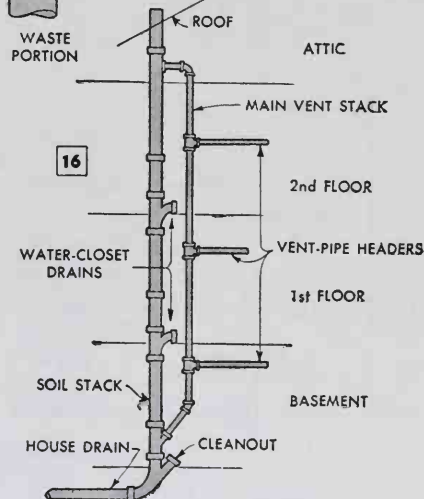
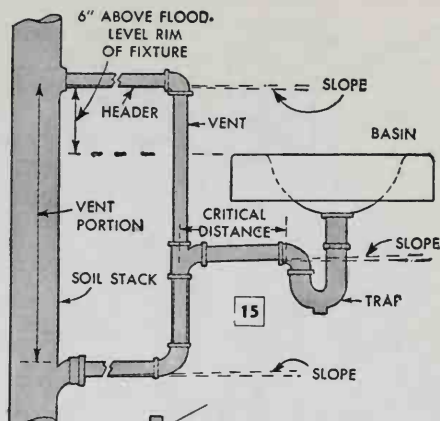
this case may be a 2-in. galvanized-steel stack, screwed to the top of the upper unit and provided with an increaser to prevent frost closure where it extends above the roof. Fig. 13A shows a tapped closet bend and detail B shows a "crowfoot" stack fitting that has two 45-deg. tappings for waste branches; detail also shows an application.

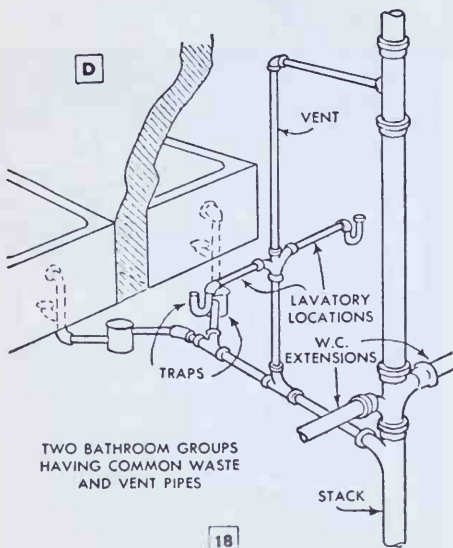
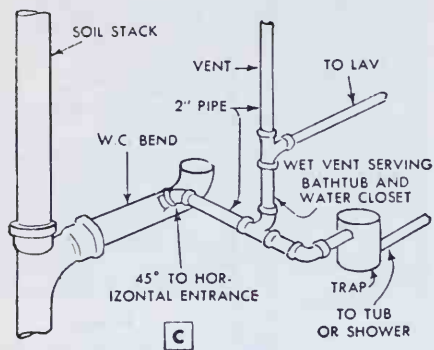
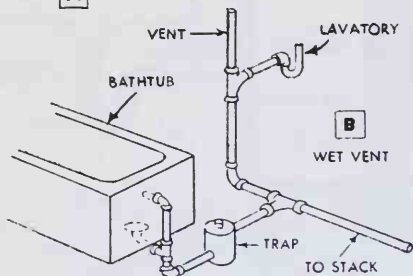
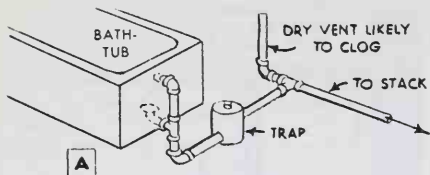
Back vents: When fixtures are too far from the stack for stack venting, as is the case with the arrangement shown in Fig. 10, they are back-vented. This is also required when a water closet, bathtub or shower discharges into the soil stack above them even though they may be close enough to it for stack-venting. The basic idea of venting a fixture is shown in Fig. 15. The vent pipe extends from the top of the drain pipe, vertically or at an angle of not less than 45 deg. from the horizontal. The distance from the vent opening to the crown weir of the fixture trap (see Fig. 22A) is somewhat critical and should not be greater than specified in Fig. 14. It should not be less than two pipe diameters. Also, vent opening should not be below the weir.

When a long-sweep outlet of a fitting serves as a vent opening, Fig. 17 A, point it in the direction of the fixture discharge. The vent pipe may connect either to the vent portion of the soil stack or to a separate stack by means of a horizontal pipe called a header, which should be sloped so that moisture collecting in it from condensation will run toward the stack or the drainage pipe. The connection of a header to a waste or soil stack should be made at least 6 in. above the flood-level rim of the highest fixture draining into the stack.

Main vent stack: When fixtures at different heights require venting, it is customary to run headers to a main vent stack, which generally is located close to the soil stack. See Fig. 16. The lower end of the main vent stack may connect to the soil stack or to the house drain; its upper end may terminate above the roof independently, or it may be connected to the vent portion of the soil stack. A vent header should connect to a main vent stack no less than 6 in. above the flood-level rim of highest fixture it serves.

Dry and wet vents: Vents such as shown in Figs. 10 and 15, which are used only to admit air to waste pipes, are called "dry" vents. They should be arranged so that the





waste discharge from a fixture cannot rise into the vent opening. This would allow deposits from the discharge to build up and eventually clog the opening. Fig. 17A shows a lavatory vent that is apt to clog because it falls below the lines, XY and XY1, which extend from the center points over the drain when the basin is full and empty, to the point where the waste pipe joins the stack. Waste that is being discharged from a fixture can rise to any point between these lines in a vent pipe connected too close to the trap. Detail B shows a similar lavatory installation in which the pipes are arranged so that the vent opening comes above the lines XY and XY1.

Detail A of Fig. 18 shows a dry vent of a bathtub installation where it is usually impossible to obtain a drop in the pipe as just described. In such cases the customary method of venting consists of connecting the waste pipe of a vented fixture, such as a lavatory, to the bathtub drain—as shown in detail B. Then one vent serves for both fixtures. The lavatory discharge washes away deposits that may collect from the bath discharge. The section of pipe serving for drainage as well as venting is called a “wet” vent. A slightly different arrangement is shown in detail C. Detail D shows an installation of two bathrooms, side by side, where both tubs are wet-vented by the common vent for both lavatories.

The drain from a back-vented kitchen sink or other fixture may be similarly used as a wet vent for a bathtub or shower. In all of these cases, a 1½-in. wet vent should not serve as a waste line for more than one fixture unit and a 2-in. wet vent for not more than four fixture units. Also, the horizontal waste branch should connect to the stack at the same level as the water-closet drain, or just below it, when installed on the top floor. It may also connect to the water-closet bend. On lower floors, the same arrangement requires a 2-in. pipe for the wet vent and its waste extension to the stack. Also, each water closet below the top floor then should be individually back-vented unless the 2-in. wet vent connects directly to the water-closet bend at a 45-deg. angle to the horizontal portion of the bend and in the direction of flow as shown in detail C of Fig. 18.

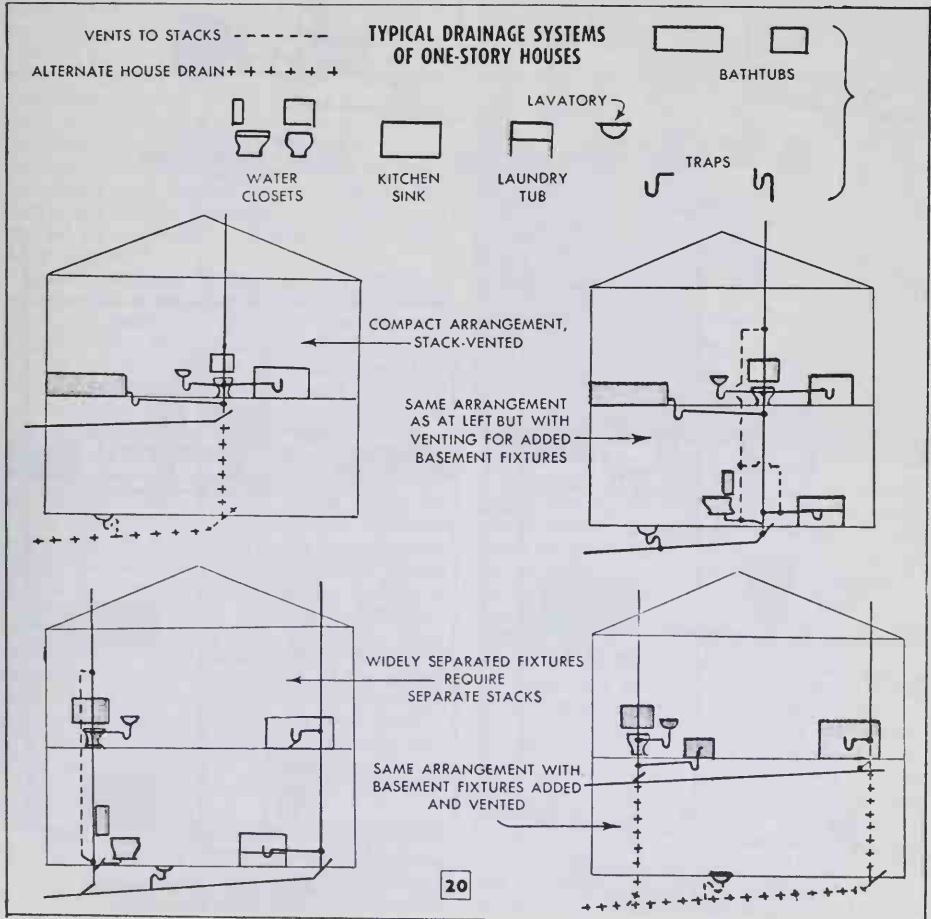
Diameters and lengths of vent pipes: Pipe used for venting should never be less than 1¼ in. in size nor less than one half the diameter of the drain pipe it vents. A vent stack or the venting portion of a soil stack should not be less than one half the diameter of the soil stack. Generally the vent portion of a soil stack is the same size as its drainage portion, but in many small one-story houses the vent portion may be of reduced size if permitted by local code.

SIZE AND LENGTH OF VENTS

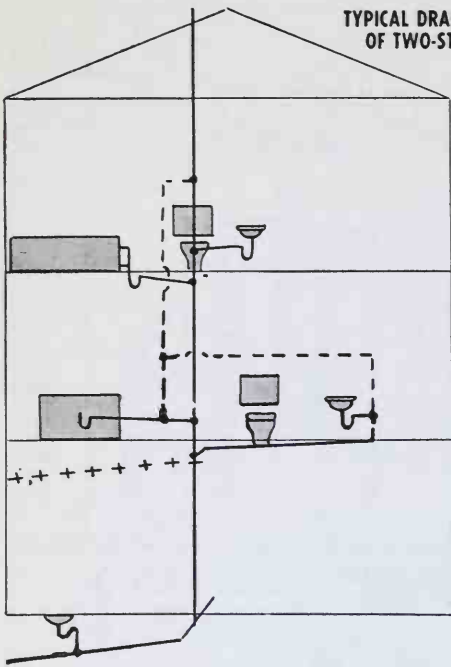
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Size of Soil or Waste Stack (In.)	Fixture Units Connected	Diameter of Vent Required (In.)						
		1 1/4	1 1/2	2	2 1/2	3	4	5
		Maximum Length of Vent (Ft.)						
1 1/4	2	30						
1 1/2	8	50	150					
1 1/2	10	30	100					
2	12	30	75	200				
2	20	26	50	150				
2 1/2	42		30	100	300			
3	10		30	100	200	600		
3	30			60	200	500		
3	60			50	80	400		
4	100			35	100	260	1000	
4	200			30	90	250	900	
4	500			20	70	180	700	
5	200				35	80	350	1000
5	500				30	70	300	900
5	1100				20	50	200	700
6	350				25	50	200	400
6	620				15	30	125	300
6	960					24	100	250
6	1900					20	70	200

U. S. Dept. of Commerce data

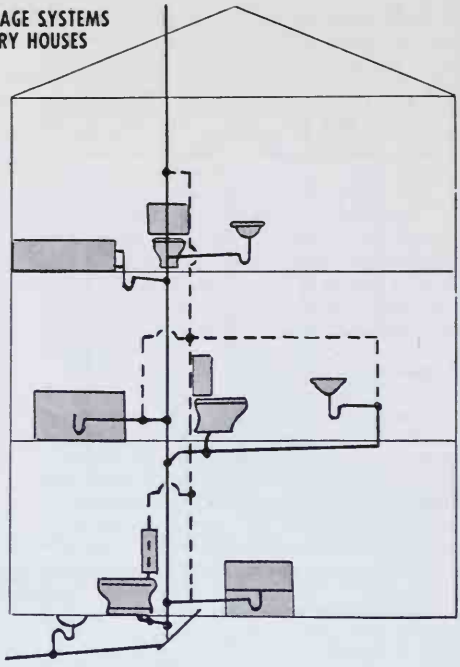


TYPICAL DRAINAGE SYSTEMS OF TWO-STORY HOUSES

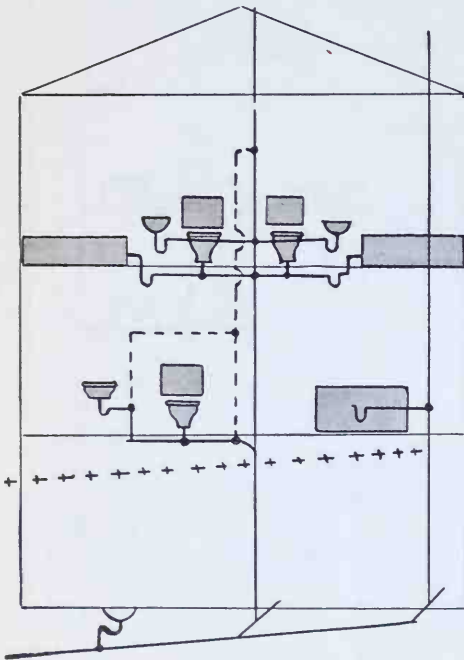


TOP FIXTURES STACK-VENTED
LOWER FIXTURES BACK-VENTED

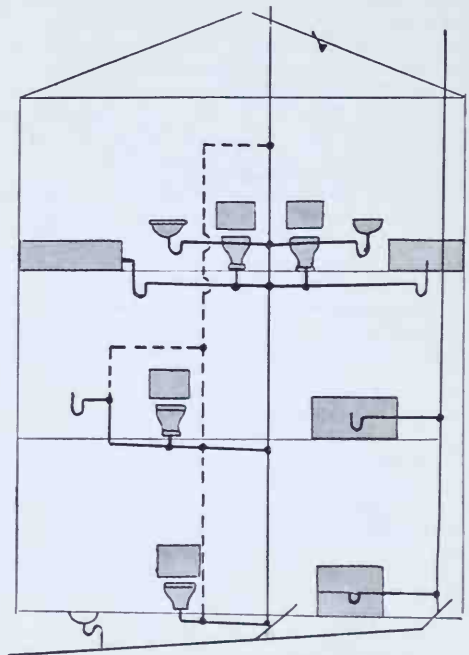
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SAME ARRANGEMENT WITH
BASEMENT FIXTURES ADDED
AND VENTED



TWIN BATHROOMS ON 2nd FLOOR
TWO STACKS AND VENTING FOR
1st FLOOR FIXTURES



SAME ARRANGEMENT WITH BASEMENT
FIXTURES ADDED AND VENTED

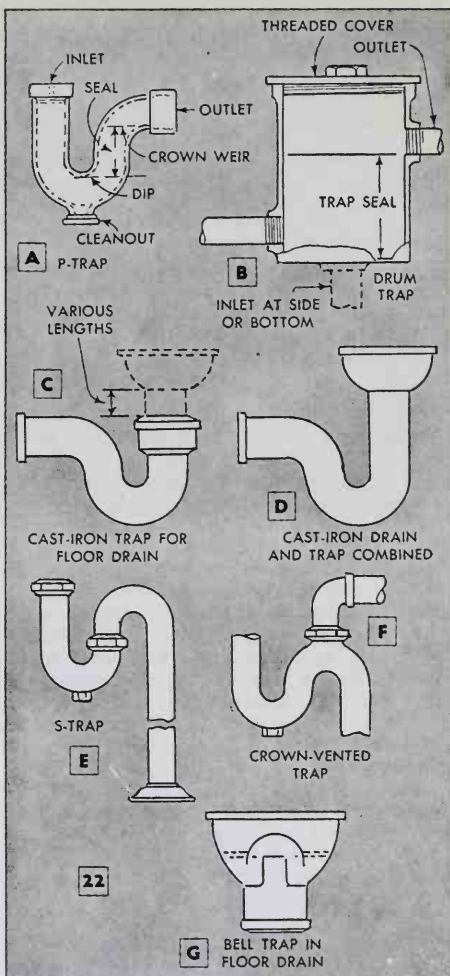
The diameter of vent piping, as well as its length, depends on the number and type of fixtures served and their fixture-unit rating. After determining the fixture-unit load, refer to Fig. 19. Locate the fixture-unit value, or the next higher value, in the second column from the left and opposite the size of the soil stack. Then get the maximum pipe lengths and diameters from the right-hand columns. For example, to find the proper size and length of vent pipe to serve the installation of bathroom fixtures, as shown in Fig. 10, totaling five fixture units, and assuming the soil stack is 3 in., you find that 30 ft. of 1½-in. pipe will serve for 10 fixture units.

As a guide to recommended arrangements of drain and vent pipes, typical drainage systems of one and two-story houses are shown in Figs. 20 and 21.

Where traps are needed: Traps are extremely important parts of a plumbing system as they prevent the entrance of sewer gas into the building without materially retarding the drainage flow through them. A trap forms a dip in the line, which retains enough water discharged through it to provide a seal. The depth of the seal, as measured from the top of the dip to the crown weir or overflow, Fig. 22A, should not be less than 2 in., nor more than 4 in. Traps having a maximum seal are known as deep-seal traps and should be used where the seal is not replenished frequently and may be lost by evaporation: for example, some floor drains.

Each plumbing fixture should be provided with a trap located as close to its discharge outlet as possible. The vertical distance from the crown weir to the outlet should not be over 24 in. One trap may serve a combination fixture such as a sink and laundry tub, if one compartment is not more than 6 in. deeper than the other and the waste outlets are not more than 30 in. apart. One trap also may serve three single-compartment laundry tubs, sinks or lavatories adjacent to each other and not more than 30 in. apart, if the trap is centrally located. For correct sizes of traps to use on various fixtures, refer to Fig. 4, table A. No fixture should be double-trapped, requiring the waste to pass through two traps in succession before it reaches the soil or waste stack, or the house drain. This does not apply to the insertion of a grease trap in the waste line from a kitchen sink if the pipe between the two traps is vented, nor to an arrangement of emptying wastes into a drain or sink. See detail C of Fig. 23.

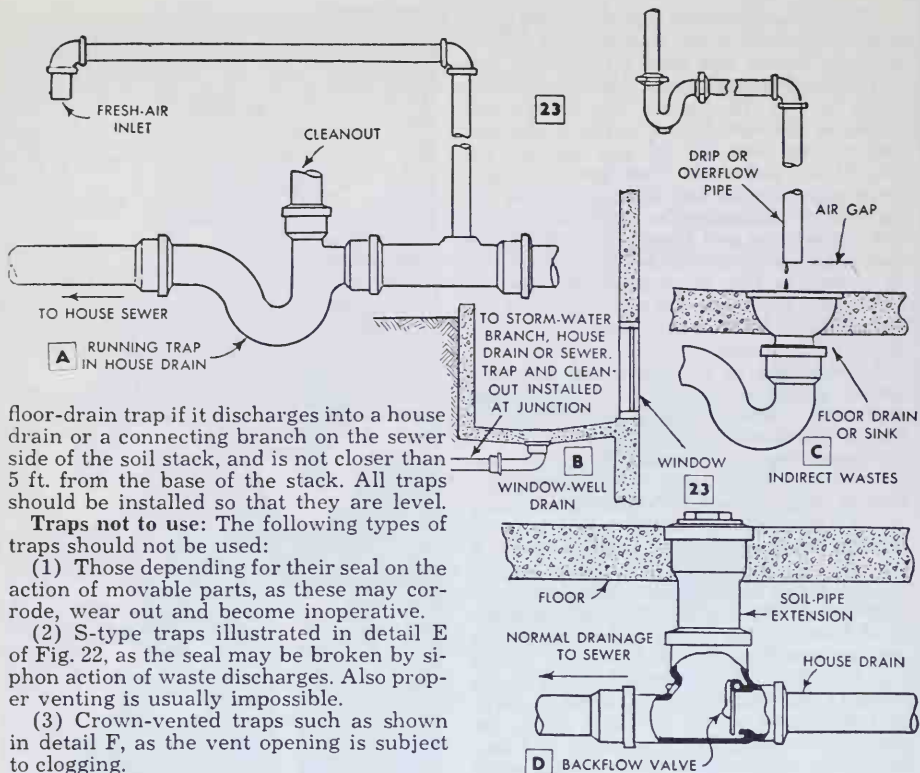
Types of traps: The kind of traps mostly used for sinks and lavatories are the gooseneck or P-type traps, such as the one shown in detail A of Fig. 22. The cast-iron variety



is installed on laundry tubs and basement sinks; the plated brass-tube kind is used where better appearance is desired. Some traps have cleanout plugs, others must be disconnected in case they become clogged. Those made of tubing have a slip joint at one end to fit on the discharge pipe of the fixture, and a union at the other end. Both joints are provided with washers.

Drum-type traps, detail B, are capable of discharging greater quantities of water, and are used mostly for bathtubs and shower stalls. They are set in the floor so that the cleanout cover is accessible, either from above or below. Traps of water closets are cast integrally with the bowl portion.

Detail C shows a cast-iron P-trap used for floor drains. Sometimes a drain and trap are combined in a single casting as shown in detail D. No venting is required for a



floor-drain trap if it discharges into a house drain or a connecting branch on the sewer side of the soil stack, and is not closer than 5 ft. from the base of the stack. All traps should be installed so that they are level.

Traps not to use: The following types of traps should not be used:

(1) Those depending for their seal on the action of movable parts, as these may corrode, wear out and become inoperative.

(2) S-type traps illustrated in detail E of Fig. 22, as the seal may be broken by siphon action of waste discharges. Also proper venting is usually impossible.

(3) Crown-vented traps such as shown in detail F, as the vent opening is subject to clogging.

(4) Bell-type traps shown in detail G, which are often used for floor drains; the seal depends on a partition which in time may be corroded or broken, thus destroying the ability of the trap to retain a seal.

House traps: Where required by local code, a "running" house trap is installed in the house drain near its outlet, as shown in Fig. 23A. Its function is to prevent sewer gases from getting into the plumbing system of the building, but it is objectionable from the standpoint that the trap reduces the discharge capacity of the drain and also causes back pressure. The fresh-air inlet or relief vent of a house trap need not be larger than half the size of the drain pipe to which it connects.

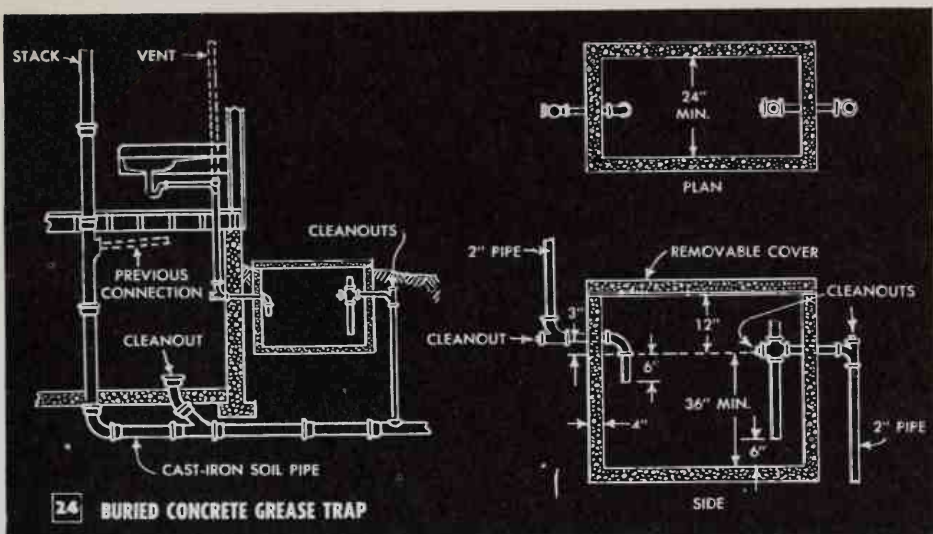
Storm-drain traps: Storm-water drains connected to combination house drains and sewers are trapped either by an individual trap in each branch or by a single trap in the main drain before it connects to the combination sewer. No traps are required for drains emptying into sewers used for storm water exclusively. Any underground trap, except a P-trap of a floor drain, should be provided with an accessible cleanout, and should be protected from frost.

Window-well and areaway drains: Often deep window wells or other areas such as

basement entrances are provided with drains, Fig. 23B. This is particularly true in locations where they are apt to fill up with snow. Since water in a trap at the drain would be subject to freezing, a trap and cleanout are provided underground in the line just before it connects to a storm-water branch, house drain or house sewer.

Refrigerator and other indirect wastes: Waste water dripping from an ice-cooled refrigerator, or the overflow of a water tank, can be discharged into a sink or floor drain as shown in Fig. 23C. An advantage of this arrangement is that it maintains a constant seal in the trap because of the continuous or occasional discharge. An air gap should be provided between the trap and the drip pipe. In case of a refrigerator, or any other device containing food, the drainpipe should be provided with a separate trap to prevent the passage of air and insects to the interior. In no case should the drainpipe of any food-containing device be connected directly to a drainage system.

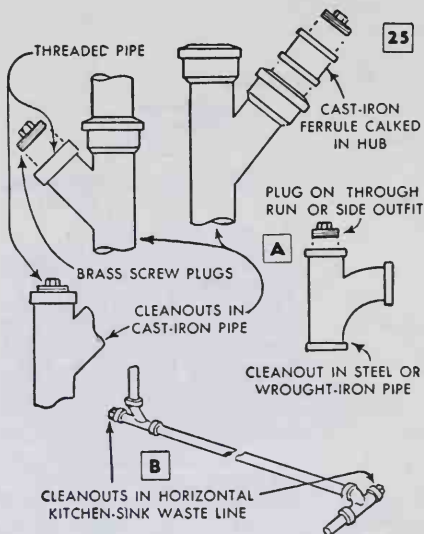
Backflow valve in house drain: Where sewers are overtaxed and backflow into house-drainage systems is likely to occur, particularly in case of combination sewers after a heavy rainfall, it is advisable to in-



stall a backflow valve in the house drain. The best location is just within the building near the outlet of the drain. If located within arm's reach under the basement floor, access is possible by simply extending the top opening with a length of soil pipe as shown in Fig. 23D. The hub is closed by means of a ferrule and brass screw plug. Where the distance from floor to backflow valve is more than 12 or 15 in., it is best to provide a concrete pit of convenient size.

Grease trap or catch basin: Some communities require a catch basin or grease trap. A grease trap should be used in an individual disposal system when grease drained into the kitchen sink is more than average. However, a grease trap should not be connected in the same waste line with a garbage-disposal unit. Grease traps may be of the small undersink variety, which require frequent cleaning, or the large kind buried outside of the house but as close as possible to the sink as in Fig. 24, which also gives recommended dimensions. The trap extends to ground level and a suitable cover is provided. As a rule grease traps are generally not required for small homes. Their use has been discontinued in many communities mostly because of the usual neglect in cleaning them.

Pipe cleanouts: Cleanout plugs are shown in Fig. 25A. One should be installed at the base of each soil or waste stack. One should also be installed near the junction of the house drain and house sewer, and at each change of direction of the house drain that is greater than 45 deg. Cleanouts are quite necessary at the upstream end of long horizontal waste lines, Fig. 25B, especially those from kitchen sinks, where congealed



grease in the pipe may cause clogging. In homes built on cement slabs or over crawl spaces less than 18 in. high, the stack-base cleanout can be projected just outside of the building wall downstream from the stack. When a cleanout is used in an underground drain, it should be made accessible by extending it to or above grade level, and directly over its location. Similarly, cleanouts for concealed piping in walls and floors should be accessible.

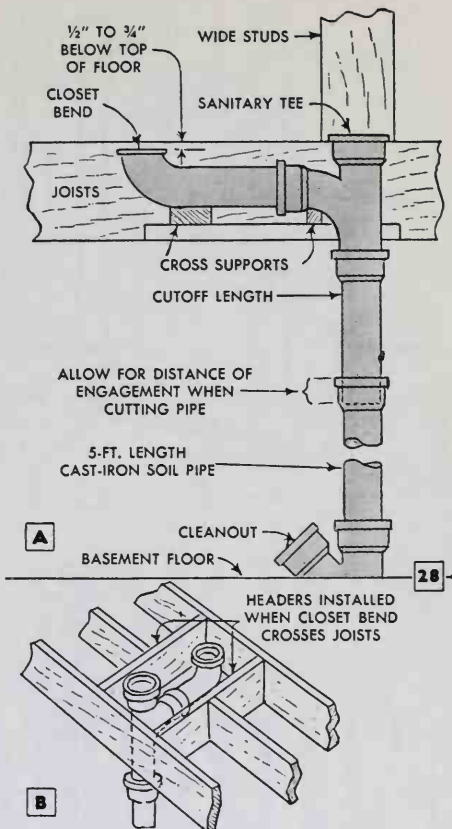
Installing drainage system in existing house: Installation of a drainage system starts with placing the stack base or foot piece; then laying the house drain and set-

Break up a strip of floor about 24 in. wide, centering at the marked lines, and dig trenches as in Fig. 27A. The 24-in. width gives just enough space to calk the pipe joints. Start digging at the stack location, just deep enough for cast-iron soil pipe to rest about 8 in. below the floor. Continue the trench toward the outlet, increasing its depth as necessary to obtain the proper slope, which can be ascertained by the method shown in Fig. 33A.

The stack base may consist of a 45-deg. Y-fitting and a $\frac{1}{8}$ bend fitted together and calked, or it may be a specially made stack base. Both are shown in Fig. 12. If the house drain is to be suspended from the basement ceiling, the fittings are arranged as shown in Fig. 27B, and the line is supported with hangers spaced not over 5 ft. apart. In either case, the stack base is adjusted so that the hub to which the stack is to connect is perfectly level across its rim and also centers around the suspended plumb bob. Tamp earth firmly around the pipe to hold it in position temporarily. Then continue to install sections of pipe in the trench. The hubs always point upstream. The proper fittings are installed at the right points to connect branch lines, using long-sweep fittings with the branch inlets pointing downstream. No double-hub nor double-T fitting should be used in horizontal soil or waste lines. To locate the fittings correctly, you may have to cut lengths of pipe. The hub and spigot ends of adjoining pipes must be concentric so that the annular space for calking is of uniform width. The trench bottom should support the entire barrel portions of the pipe; therefore slight concavities are dug under the hubs as shown in Fig. 33B.

The trench is not filled with earth until the drainage system has been tested for leaks. This will be explained in detail later. When laying a house drain it is sometimes more convenient to start laying the pipe from the outlet toward the stack. When this procedure is followed the stack-base assembly must be shifted about $2\frac{1}{2}$ in. so that the last joint can be made, after which it is forced back to its original position, adjusting the hub to get it level. When the house drain has been completed, dig a space under the stack base about 18 to 24 in. square and about 10 in. deep. Fill this with concrete as shown in Fig. 27C for good stack support.

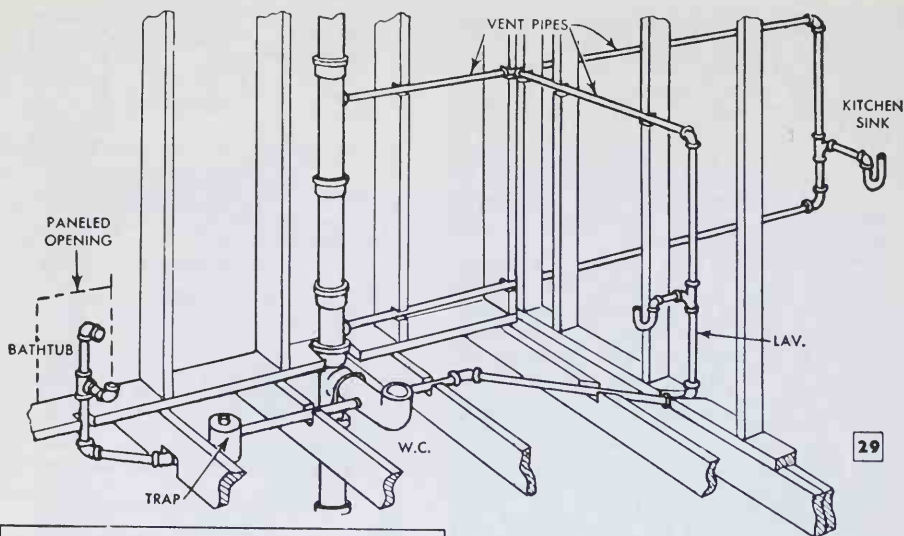
Setting up the stack: After the concrete has set for a day or so you can begin to assemble the stack. If a waste connection from the laundry tub goes to the stack, install a T-fitting and calk the joint, making sure that it is plumb. Where basement waste pipes are not so connected you install a full 5-ft. length of soil pipe. Then cut holes in the first floor, one through the partition sill or next to it, depending on the



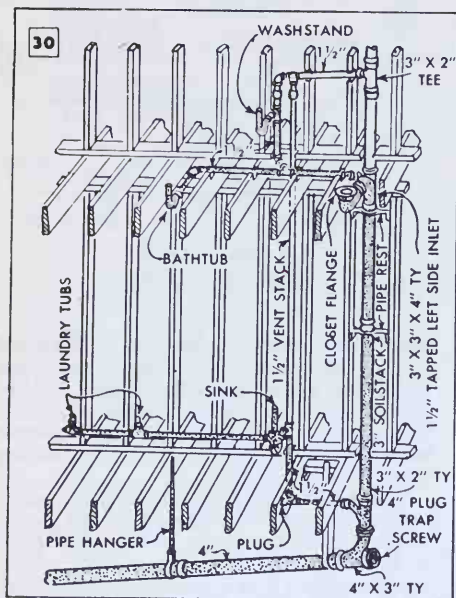
exact stack location. Another hole should be cut for the outlet of the water-closet bend, if a water closet is planned for the first floor. It usually is necessary to open the floor to install pipes, although an open basement ceiling often permits installing pipes from below.

The second pipe length must be cut short so that the sanitary T-fitting for the water-closet connection will be at the right height as shown in Fig. 28A. The closet bend or pipe extension to it is arranged at the proper slope so that the outlet of the bend comes $\frac{1}{2}$ to $\frac{3}{4}$ in. below the top of the floor. If the bend is too long it can be cut. One or more supporting crosspieces on cleats nailed to joists are used to support horizontal soil pipe between joists. Where a closet bend or extension crosses joists, headers are provided as shown in Fig. 28B. The stack also must be supported at least every 8 ft., as described in Section 3. It will be necessary to remove a strip of plaster from floor to ceiling, Fig. 32A, when soil pipe is set in a partition. You may have to "box out" the wall to accommodate the pipe.

After the stack has been completed to



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U. S. Dept. of Agriculture illustration
**SUPPORTING AND ROUGHING-IN A SIMPLE SYSTEM
 HAVING CONTINUOUS WASTES AND VENTS.**
 DRAINAGE PIPES ARE STIPPLED AND VENT PIPES ARE
 OUTLINED

the first-floor level, check the exact location of connections to waste pipes, select fittings accordingly and cut the pipe where necessary. In case no water closet is planned for the lower floor, a connection may be required for the waste line from the kitchen sink, although this may also be brought to the stack underneath the floor. Continue building up the stack to the water-closet extension on the second floor.

Above this point the fittings for waste and vent connections are incorporated, and the stack is continued so that it will extend no less than 6 in. above the roof, shingles having been removed and the roof boards already cut. Stack flashing is installed when the shingles are replaced. Openings in floors and partitions where pipes are installed should be ratproofed with sheet metal.

Concealed waste and vent pipes: Concealed work in new-house construction is comparatively simple but in existing homes some flooring must be taken up and plaster removed. To cross joists and studs, notches are cut in them, as shown in Figs. 29 and 30. Where joists or studs are weakened by notching, they should be reinforced. To connect drainage and water-supply pipes to a built-in tub, accessibility is provided by opening the wall, framing the opening and then providing a door or panel, as in Fig. 31. A bathtub trap must be accessible. Drum traps are the most adaptable for underfloor work, being arranged so that the cover is flush with the floor or is accessible from below.

Opening walls and floors: Fig. 32A shows how a minimum amount of wall covering is removed to install waste and vent pipes. After marking off the exact location of the pipes on the walls, cut through plaster and plaster base as required. Vertical cuts through plaster are made alongside studs, and cleats are nailed to the studs for fastening the wire lath, as shown in detail B. In small bathrooms flooring may have to be removed entirely from wall to wall to uncover an area large enough to install the pipes. If cutting a floor is necessary, use a

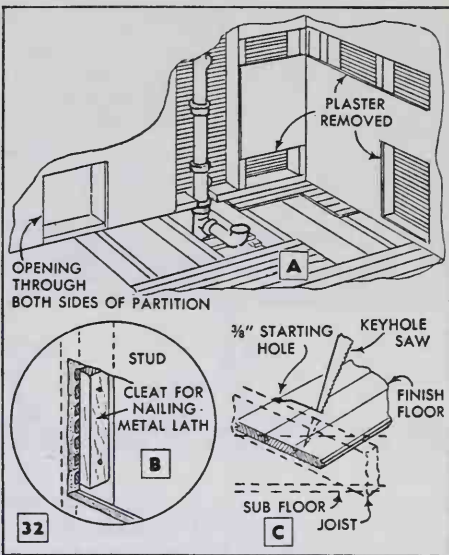
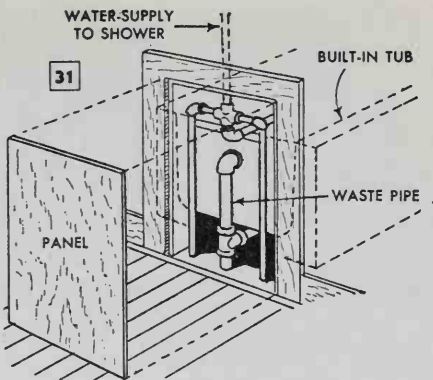
keyhole saw, starting to cut from a small hole and sawing alongside the joists. See detail C. This permits nailing a cleat to the joists as a base to which the cut floor boards are later nailed.

Installing house sewer: Although the house sewer may be installed before the house-drainage system, it is often done afterwards. Its size should not be less than that of the house drain, and it may have to be larger, as for instance when storm water is emptied into it. It is important that the joints be made watertight and rootproof. The line should be as straight as possible and should be below the frost depth. The usual slope is $\frac{1}{4}$ in. per ft., and the method of determining the slope is shown in Fig. 33A. Various kinds of pipe are used for house sewers as described in the section on pipe. An acid-resisting type of pipe is needed when the soil contains cinders and ashes as metal pipe then is subject to excessive corrosion. When some types of pipe other than cast-iron pipe are laid in filled or unstable soil, they should be placed on concrete pads for uniform support.

Digging trenches: Digging a trench in clay or other compact earth usually is safe, but in unstable soil, particularly sand, it is necessary to prevent the sides from caving in. "Shoring" for sides to prevent cave-ins consists of planks—or forms rented from a concrete contractor—which are suitably braced as shown in Fig. 33C. The pipe should be placed on compact, undisturbed earth. Rocks at the trench bottom should be removed. If the bottom is very rocky excavate 4 in. below grade and backfill with fine gravel or coarse sand to assure uniform support of the pipe.

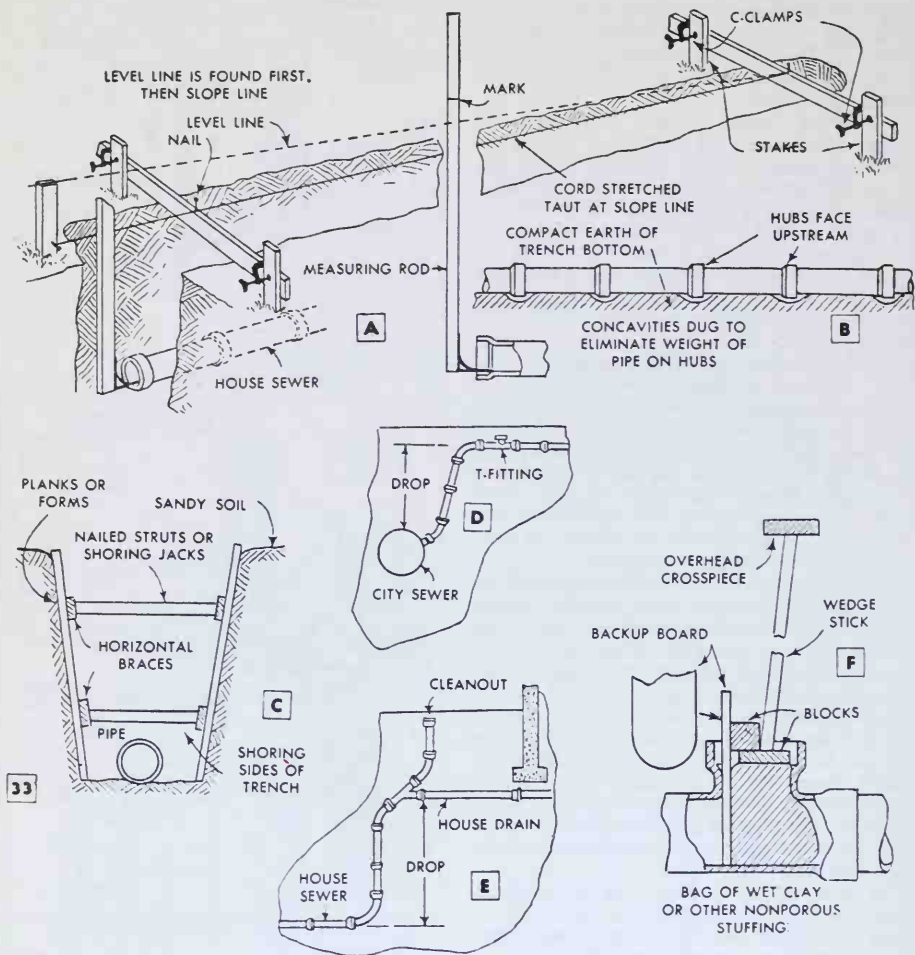
In case the drop from the house-drain outlet to the city sewer or individual septic tank is much greater than can be negotiated with pipe slope, an additional drop may be required. This can be provided by a short steep slope near the city sewer as in Fig. 33D. The drop can be located also at the house-end of the line as in detail E. A drop that slopes more than 45 deg. from the horizontal should be provided with a cleanout opening. In no case should a drop be located within 15 ft. from the entrance to a septic tank, since the accelerated velocity of the drainage flow would interfere with the proper action of the tank. A T-fitting inserted at the outlet end of the house sewer, detail D, provides a means of sealing this end of the line when making a leak test on the drainage system after it is completed.

Connection to city sewer: Connection to the city sewer usually is done by or under supervision of municipal employees. Vitrified-clay sewers generally are provided with 6-in. Y-fittings at each lot location for attachment of house sewers, requiring only



the removal of the plug and the insertion of a curved section of pipe. Concrete sewers generally must be tapped and a pipe stub cemented in the hole. The trench in which the house sewer is laid is not filled until after testing has been accomplished. When filling a trench containing a pipe that can be damaged, such as vitrified-clay pipe, avoid throwing large stones and rocks in with the fill until the pipe has been covered for a depth of at least a foot or so. Thus you avoid unnecessary breakage.

Testing for leaks: After a drainage system has been completed, it should be tested for leaks before the installation is approved. To make the test, close the street end of the house sewer with a test plug as shown in Fig. 12D of Section 2 or accomplished by plugging the pipe with a bag of wet clay as in Fig. 33F. Close all other openings below the stack terminal. On waste pipes you simply use pipe caps. Closet-bent and floor-



drain openings can be closed with test plugs or bags of clay.

When all openings are made leakproof, fill the system with water through the stack terminal, using a hose. Then inspect all the joints and pipes for leakage. If leaks are found at joints, the cause usually is defective calking, although a pipe may be defective also. Such joints are recalked or defective pipe replaced after letting out the water by opening the house sewer. The surfaces to be calked should be thoroughly dry. After the final test, the T-fitting in the house sewer is closed by cementing in a disk.

Frost protection and insulation: Besides the need of burying the house sewer at a depth sufficient to prevent freezing, soil and

waste pipes installed in outside walls or in unheated spaces under floors often require insulation against freezing. Insulation is applied all around the pipe, especially between them and the outside walls. Cold drafts in partitions and floors may be stopped by headers nailed across the studs or joists. Sometimes warm air admitted through a register from the basement is highly effective in preventing frozen waste pipes. Noise caused by water being discharged through soil and waste pipes is sometimes objectionable. It may be amplified considerably if the pipe is in contact with a wall. Where such effects can be anticipated, the pipes should be wrapped with soundproofing insulation when they are installed.



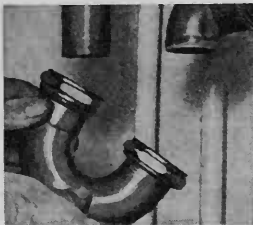
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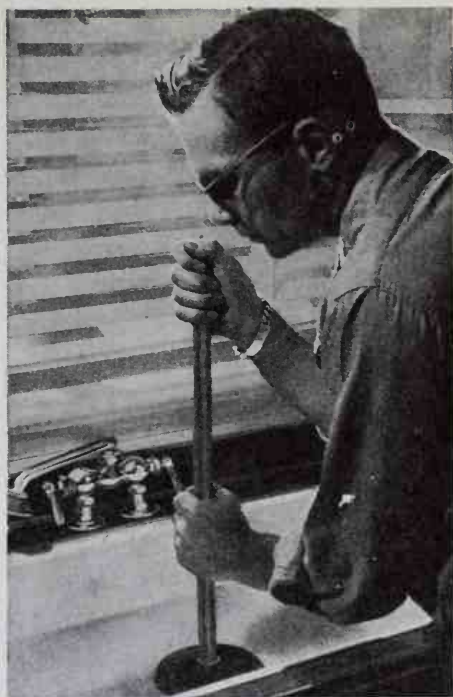
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Don't pour cooking fats and grease into kitchen sink but discard with garbage and wipe away traces from pans with paper towels or napkins before washing

Flush sink drain with scalding-hot water for 2 or 3 minutes each day. When waste pipe is clogged, remove trap so drain auger can be easily advanced to obstruction



5

Drainage Troubles-Causes and Cures

AMONG TROUBLES EXPERIENCED in drainage systems, the most common ones are clogging of pipes, especially those from kitchen sinks; root penetration into house sewers; backflow of sewage into house drains and the entrance of sewer gas into houses. Less common are freezing of drainage lines, leaky pipes and drainage-system noises. Some of these troubles can be remedied easily by most homeowners; others are more involved but can also be done by homeowners at a considerable saving in cost. In any case the problem encountered becomes much easier to solve when you can diagnose it correctly, locate its source and know where and how to apply an effective remedy. Besides curing an existing trouble, measures should be taken to prevent its recurrence.

Clogged sink drains: Most stoppages in kitchen-sink waste lines are caused by accumulations of congealed grease and fat emptied into the sink. Coffee grounds, food particles and lint are held in this grease deposit, which gradually builds up until it obstructs the pipe completely. Generally

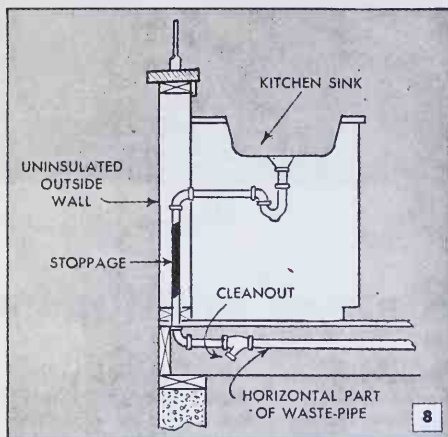
the trouble occurs in a horizontal portion of the waste pipe. Therefore this part should always be provided with an accessible cleanout, shown in Fig. 8 and in Fig. 25B on last pg. Too steep a slope in this section also causes the water to drain away fast which is apt to leave solids in the pipe, shown in Fig. 3, on this page. If part of a sink-waste pipe is enclosed in an outside wall, as in Fig. 8, grease is likely to congeal here. Clogging seldom starts at the trap, as hot water running through it constantly at dishwashing times tends to keep it clear. The amount of this hot water, however, is seldom enough to heat the waste pipe and melt grease at some distance from the trap.

Fat, grease and oil never should be discarded into a sink, lavatory or water closet. Fats, as well as hardened crusts scraped from cooking utensils, and leftover bits of food should be collected in cans that can be thrown away with garbage, Fig. 1. Remaining traces of grease should be wiped up with paper towels or napkins as in Fig. 2.

The most effective method of preventing stoppage from congealed grease and oil that

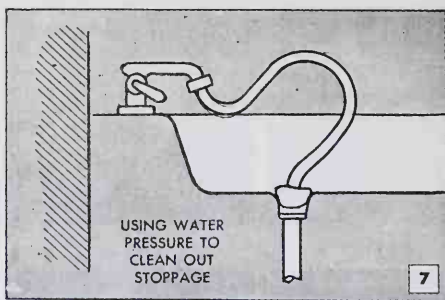


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are carried into a drain with dish water, is to run a copious amount of scalding water through the pipe for a period of at least 2 or 3 minutes after each dishwashing, Fig. 3. As soon as drainage through the pipe slows up, practically an entire tankful of scalding water should be run through it. The temperature control on the water heater should be set to "high" about an hour or so before such flushing.

Drain-pipe chemicals: If the scalding water treatment does not open up a slow drain, you can use a strong chemical cleaner. Most of these consist of sodium hydroxide (caustic soda), with boraxite and other ingredients added to intensify their action. Mixtures of caustic soda with sodium nitrate and aluminum turnings are also used, in which case ammonia gas is formed and dissolves the grease. The use of lye (caustic soda) alone frequently adds to the grease



accumulation more rapidly than it can be removed by water and then increases the stoppage. When added to water these chemicals effervesce violently and produce considerable heat.

As these drain-cleaning chemicals are extremely caustic they must be handled with care to avoid getting them or the solution on hands, arms and face. Also avoid splashing the chemical on clothes, wood, painted surfaces or aluminum. If this happens accidentally, flush with cold water, then immediately apply vinegar and finally rinse with cold water. After the chemical has been put in the drain pipe, do not use a plunger to hasten the removal of the grease accumulation. Keep water out of the can containing the chemical; if the content is wetted and the can lid is closed tightly, sufficient pressure may be produced inside to cause the can to "blow up."

A chemical cleaner should not be used in drain pipes that are completely clogged. It is necessary to have a slight flow to carry the chemical down to the point of obstruction, since it must be in contact with the obstruction to be effective. Pouring the chemical into a sink drain merely lets most of it settle in the trap. The best method is to remove the trap, as in Fig. 4, and insert the chemical in the pipe beyond the trap location as in Fig. 6. Use about a quarter of a full can and wash it down the pipe by slowly pouring in about a quart of water at intervals. Then replace the trap and after about 15 min. check to see if water drains away faster. Repeated chemical treatments are sometimes necessary. When good drainage is resumed, flush the pipe with scalding water for about 5 min.

Mechanical methods: When a sink or lavatory drain is completely stopped, mechanical methods must be employed usually to remove or pierce the obstruction. First try a suction-cup plunger, as in Fig. 5, a force pump, or use water pressure from a faucet, Fig. 7. In this case the hose must be securely attached to both faucet and sink drain. Be sure that there is enough water in the sink to provide a good seal when using a suction cup, and then work it up and down

with quick, forcible strokes. These methods can be effective only when the obstruction lies between the sink and a vent pipe. If it lies beyond the vent pipe, air is admitted, which makes the suction cup ineffective. If water pressure is used, water will run up into the vent pipe instead of providing a positive pressure against the obstruction.

When these methods do not dislodge the obstruction, run a 15 to 25-ft. by $\frac{3}{8}$ -in. drain auger through the pipe, as in Fig. 9. Remove the trap and elbow from the pipe and feed the auger into it. Rotate it, then feed in farther and rotate again, continuing in this way until you have pierced the obstruction. If the latter cannot be reached from the sink location, open the cleanout plug at the beginning of the horizontal section of the pipe and insert the auger at this point. It is impossible to remove all the grease from a pipe with an auger, but after a hole has been bored through the grease you apply the chemical treatment followed with a thorough flushing with scalding water.

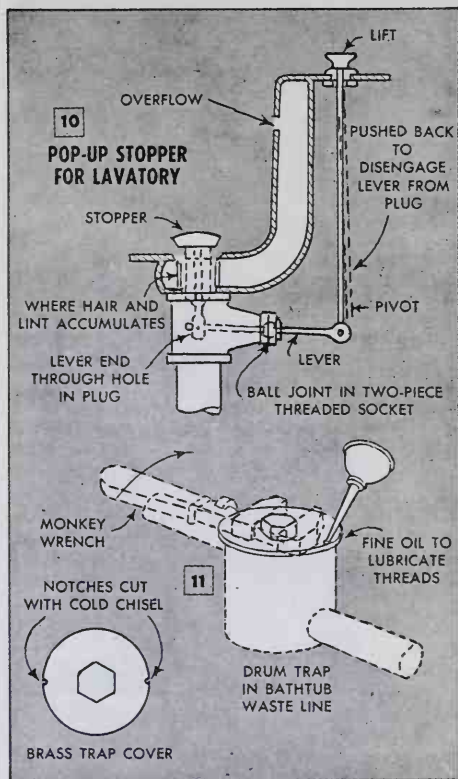
An alternate method is to heat the pipe in order to melt the grease. You can use a blowtorch flame against the pipe if there is plenty of clearance between it and other inflammable material near it. An asbestos shield should be used to protect the latter



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Lavatory drains: Many lavatories have a pop-up type of drain stopper, Fig. 10, which tends to accumulate hair and lint just below the lavatory outlet. A length of wire having one end bent to a small hook can be used to pull out this accumulation, after removing the stopper. To do this you unscrew the ball-joint socket so that the short horizontal lever can be disengaged from the lower end of the stop plug. If the trap is clogged it may be cleared sometimes by simply using a suction cup; in more obstinate cases, it may have to be removed for cleaning.

Bath drains: Accumulations of lint, hair and pieces of soap can cause clogging of bathtub and shower drains. Soap usually dissolves in a short time and passes away. When an accumulation clogs the trap and stops drainage flow, the cover of the trap must be removed, as in Fig. 11, to clean it. Turning the cover loose often can be made easier by letting some fine oil run over the edge of the cover and onto the threads. Tap the cover lightly while applying turning force. If it does not budge, chip two notches in the edge with a cold chisel and use a driving punch and hammer to turn the cover. When replacing it, be sure that the fiber gasket is thoroughly clean and in good condition. If defective, replace it rather than take a chance on admitting sewer gas. Putting a small amount of cup grease

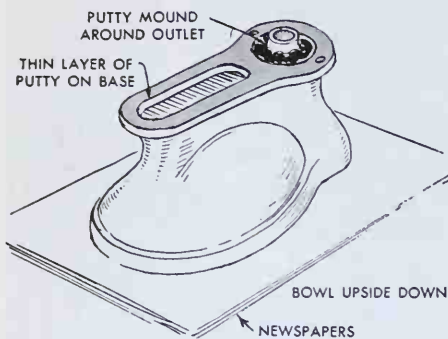


on the threads will make it easier to screw on the cover and will help also in getting a tight seal.

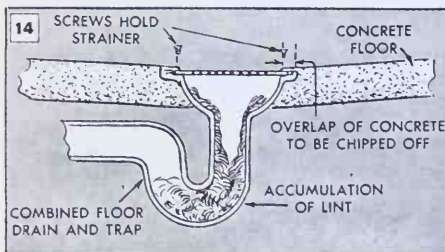
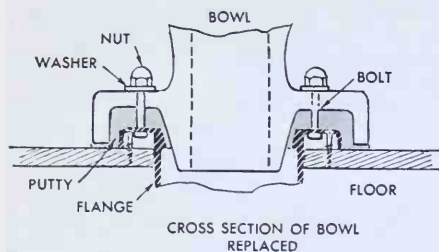
Water-closet stoppages: When a water-closet drain is stopped, try dislodging the obstruction with a suction cup first. If the suction cup is not effective, use a water-closet auger. Often paper is caught by the spiral tip of the auger and can be pulled



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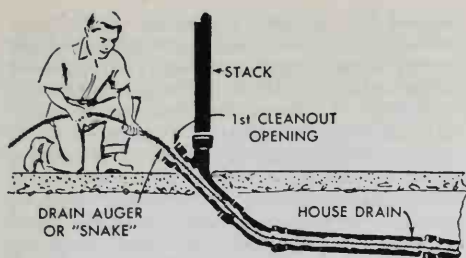


back. If a cake of soap is lodged in the trap, traces of it will show on the end of the auger. Soap is not easy to remove, but a quantity of hot water poured into the bowl will soften the soap and permit it to wash away.

Removing closet bowl: If the obstructing object cannot be removed with these methods, and it seems to be wedged in the trap, it will be necessary to remove the closet bowl to get at the obstruction from the outlet opening. First shut off the water supply and empty both the tank and the bowl by siphoning or pumping and sponging. Then disconnect the water-supply pipe to the tank, loosen the bolts holding the tank to the bowl if any, and also loosen the pipe connection between the tank and bowl, after which you can lift the tank off and carefully set it aside on newspapers. Some bowls can be removed without the need of removing the tank by only loosening the connection between the two. Next, remove the seat and loosen the bowl where it attaches to the floor, Fig. 12. Jar the bowl by hand to free it from the putty seal or gasket between the bowl and flange. Then lift off the bowl and set it upside down on newspapers. In this position the discharge opening is accessible.

Replacing closet bowl: Before replacing the bowl, clean away old putty from the base and flange. Dry the surfaces thoroughly and apply new bowl-setting putty to both bowl and flange, as shown in Fig. 13. About 3 lbs. of bowl-setting putty will be required; ordinary putty cannot be used. Build up a mound of putty around the outlet opening or "horn" of the bowl. Also apply a thin layer to the base where it contacts the floor, but keep the bolt holes clean. If a gasket is used instead of putty, replace it rather than take a chance on the old one. Contacting surfaces, in case a gasket is used, should be thoroughly clean. When replacing the bowl get it in exactly the same position as it was originally. Press it down to squeeze out the surplus putty and replace the nuts, tightening them carefully until the bowl rim is level. Then reconnect the tank if it was removed. If there is any water leakage from the puttied joint, take off the bowl again and reset with more putty. The bowl and tank should be handled with utmost care. They are made either of porcelain or vitreous china and can be chipped and scratched easily.

Floor drains: Floor sweepings and lint from washing clothes may cause floor drains to clog. Often the strainers, which are removable, are firmly held by the concrete floor which then must be chipped away a little in order to free them, Fig. 14. A long-handled spoon or ladle is handy to remove sediment from the trap, although



a drain auger may be needed to loosen hard accumulations. When an opening has been made, you can apply water pressure from a garden hose to flush out the trap. If the trap is closed with congealed grease, first use a drain auger followed by a chemical drain cleaner and afterwards scalding water, as already explained. It is best to clean out floor drains periodically instead of waiting until they are completely stopped and the floor is covered with water.

Stoppages in house and storm drains:

Where city sewers are not overtaxed and storm water from sewers does not back up into a house, the rise of water and sewage through floor drains indicates stoppage either in the house drain or in the house sewer. The cleanout, which usually is provided at the base of the soil stack, is the starting point for using a large drain auger or a spring-steel "snake" fitted with a spearhead. If drainage is restricted but is not entirely stopped, the obstruction can sometimes be flushed away by water pressure from a hose, in which case the nozzle is left on the hose and is adjusted for maximum force. If the obstruction is not found before reaching the cleanout opening at the outlet end, as in Fig. 15, you continue from this opening. When brass covers of cleanout openings are hard to remove, follow the same procedure of loosening them as explained for drum traps.

Where downspouts for roof drainage connect to storm or combination drains, soggy leaves sometimes cause obstructions, especially at turns. Remove the downspout and proceed with a drain auger until the mass of leaves has been loosened sufficiently to permit flushing them away with a hose. Leaf guards in gutters at downspout leaders avoid such trouble.

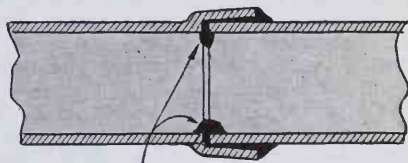
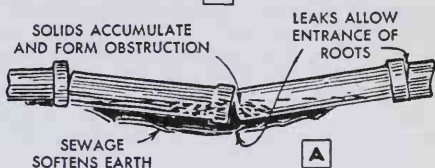
Root-filled house sewers: If the house drain is clear, but water from waste and drain pipes within the house causes flooding of the basement floor, the stoppage obviously must be in the house sewer or main sewer. This is reached through the cleanout opening which is closest to the outlet of the house drain. Penetration of tree roots into sewers is the most common cause of stoppage. Fig. 16 shows a section of pipe



16



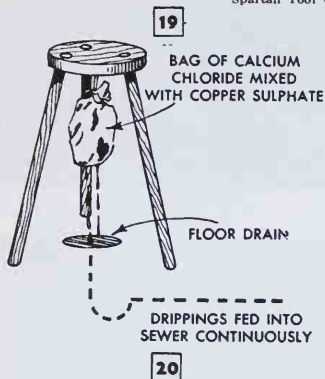
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18



Spartan Tool Co. photo



completely filled with tree roots. Some trees, particularly willows, poplars and cottonwoods, often send their roots out as far as 20 or 30 ft. in search of water. Slight cracks often found at mortar joints of pipe are enough to admit the hair ends of roots, Fig. 17. Once inside the pipe, roots grow fast and send out countless new roots. Any kind of pipe that has a leaky joint or a cracked wall is subject to root invasion. Other causes of stoppage in sewer lines are sagging sections of pipe in filled earth, as shown in Fig. 18A, mortar at joints that has gotten inside the pipe and was not wiped away, detail B, and filling up of broken pipes that have been crushed when not buried deeply enough, or have burst due to freezing.

Temporary control measures: The best tool for cutting roots inside a sewer pipe is an electrically driven root-cutting tool, shown in Fig. 19. Plumbers in localities that are especially subject to this trouble usually have such equipment. Cutting the roots and cleaning out the line, however, is only a temporary measure for immediate relief and does not prevent recurrence.

Other temporary control measures consist of applying some chemicals that kill or

retard root growth. Repeated applications of caustic drain-cleaning chemicals retard root growth. Copper sulphate (blue vitriol) kills roots if applied in sufficient concentration over a period of time. One way to apply it continuously is to keep a strong solution in a container over a floor drain, arranging it so that the liquid will drip into the drain. The container can be provided with a petcock or with a suitable wick for slow, continuous dripping. Another dripping method, applicable where the air in a basement is sufficiently humid, is to mix copper sulphate and calcium chloride and hang the mixture in a porous bag over a floor drain, as in Fig. 20. The moisture retained by the calcium chloride dissolves the copper sulphate and drippings of both are fed into the sewer.

A single application of any chemical solution is not effective as it runs down the sewer and contacts the roots only momentarily. A 24-hr. or longer soaking application can be made if the house-sewer outlet can be plugged so that the solution will be retained in the line. However, as roots usually enter a sewer pipe through cracks at the bottom of joints where liquid is constantly available, the drip method is usually sufficient. Copper sulphate should not be introduced into a drain or sewer containing grease, as the chemical will coagulate the grease and form a nonsoluble substance that can cause further clogging. The application of chemicals should be greatest during spring and early summer months when root growth is rapid.

Replacing sewer pipe: The only permanent cure for root invasion is to seal the pipe joints so that roots cannot enter. If the pipe is not broken it is possible to enclose it completely in a layer of concrete as shown in Fig. 21, although the work and cost involved are no less than laying new pipe. Generally only a section of the line must be replaced, but while the job is being undertaken, it is often best to renew the entire line properly as assurance against future trouble.

Mortar joints of vitrified-clay pipe often are defective because of careless workmanship, although mortar joints properly made can be rootproof. Special pipe-joint compound, which is poured hot and remains slightly flexible, gives lasting protection when correctly applied. When replacing a section of vitrified-clay pipe, the damaged portion is broken up and removed, after which new pipe is laid. The joints are first calked, then sealed with pipe-joint compound. Fig. 22 shows how the two last sections of pipe can be fitted together so that the hub of one section need not be broken.

Other types of pipe are of value in preventing root invasion. On some types the

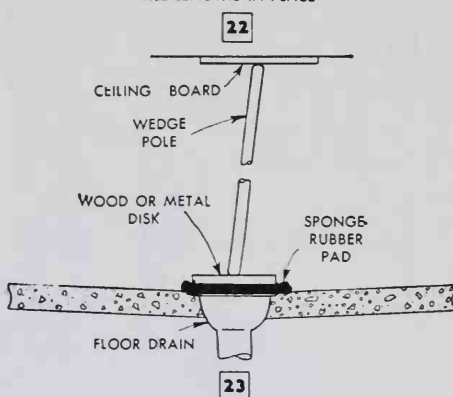
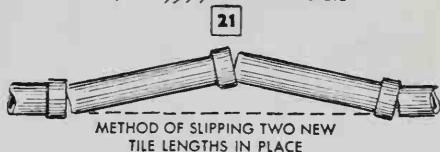
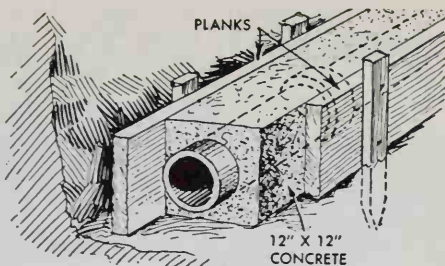
joints can be wedged together tightly in couplings; others have heavy-duty rubber-band seals that are forced between pipe ends and couplings. Cast-iron soil pipe with tightly leaded joints also gives adequate protection against root penetration.

Backflow from sewer: In localities where city sewers are overtaxed and occasionally cause sewage to back up into houses, the best remedy is to install a backflow valve. In case of emergency use temporary measures of preventing sewage from rising in basements through floor drains consist of sealing the drains with sponge-rubber disks held down tightly under wood or metal disks with a wedge stick, as in Fig. 23. In cases where the sewage may rise into a water closet located in the basement, the bowl must be plugged tightly in a similar or other effective manner.

Frozen drainage lines: A house sewer and other buried drainage lines should be below frost level to prevent freezing. Where this is impossible the lines should be insulated and the insulation wrapped in a moistureproof covering. Freezing of inside drainage lines can occur only when a house is left unheated, or when drainage lines are located in unheated spaces. Measures to prevent them from freezing should be taken when the lines are installed. When freezing does occur, the most effective measures to thaw out the frozen section depend on its location and accessibility.

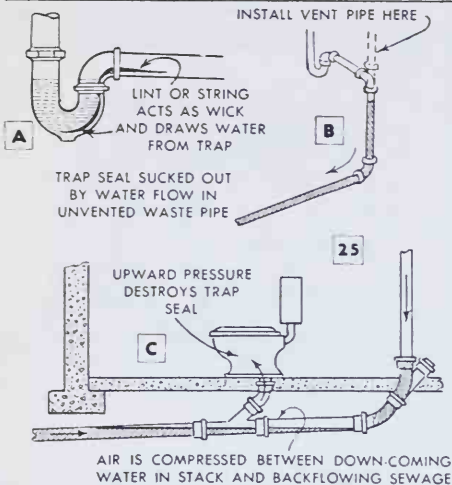
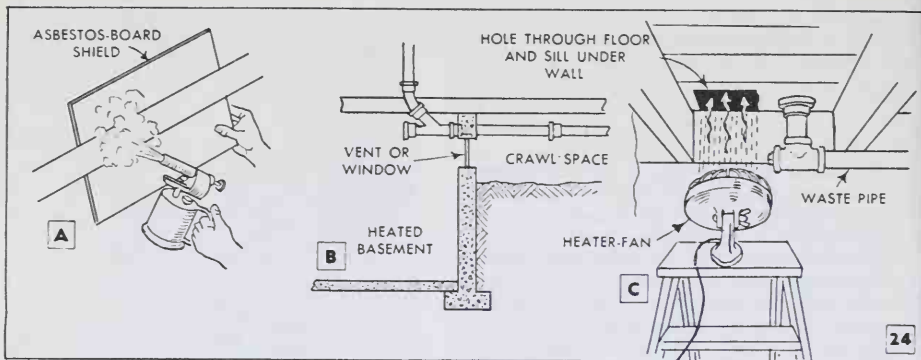
In crawl spaces and other unheated places having sufficient room, a blowtorch can be used to heat the pipe if nearby wood and inflammable materials are protected with asbestos board, as in Fig. 24A. The flame must not be applied at joints of cast-iron soil pipe. This may melt the lead. Rags also may be wrapped around the pipe and kept soaked with hot water, or an electric heater can be set under the frozen section of pipe. After thawing the ice inside—or grease congealed by low temperature—it should be insulated to prevent recurrence and a quantity of hot water run through it daily during cold weather. If a crawl space is located next to a basement, an opening between the two can be made, as in detail B, to admit some heat into the crawl space. In this case, the walls should be insulated. Vertical lengths of drainage pipe in outside walls can also be protected against freezing if the space between studs is provided with some heat from the basement. To help thaw out a section of such a pipe, hot air from an electric heater-fan can be directed into a basement opening, as in detail C.

Besides heating a pipe from the outside, it can also be heated from the inside. Assuming that it is full of water above the frozen section, it is best to run a hose or



length of rubber tubing into the pipe and down to the obstruction so that the water can be pumped out. Then the pipe may be filled with scalding water, or chemicals may be introduced. A chemical cleaner which generates considerable heat can be flushed down to the obstruction. Another chemical that has been found effective is antifreeze of the kind used in auto gas tanks.

Protecting traps in unheated houses: Considerable damage in a drainage system can result by leaving water in traps and water closets in an unheated house when it is closed during cold weather. The water freezes and cracks the traps or closet bowls. Proper precautions to prevent this consist merely of removing all water from the traps and substituting a nonvolatile oil, such as kerosene, which will not congeal. Water is easily removed from washdown-type water closets by sponging out the trap. All siphon-jet water closets cannot be completely emptied in this manner. Those having a jet hole in the bottom of the bowl can be emptied by inserting a rubber tube through the hole and pumping out the water from the passage below the bowl.



Sewer gas: The loss of water seal from traps by evaporation is the usual cause of getting sewer gas into a house. Traps that are seldom used, such as some floor traps, are especially susceptible. Adding a small amount of kerosene, which floats on the water and thus prevents it from evaporating, can be used. An alternative is to refill the traps with water frequently. Trap-seal loss can be due to other causes also. Traps can be emptied by capillary attraction of water through a string, a small rag or an accumulation of lint lying partly in and partly out of the trap, permitting it to act as a wick, as in Fig. 25A. In improperly installed or vented drainage systems, or where vents are clogged, water in a trap can be sucked out by siphon action or by the momentum of water flowing through the waste pipe, as in detail B. There are also cases where air pressure in or near a fixture may force water out of a trap, as shown in detail C. This is likely to occur in an overloaded drainage system or when a sewer backs up, particularly in basement fixtures such as a water closet located near

the stack. The trouble can be cured by proper venting. Loose joints or cracks in pipes may permit the leakage of sewer gas into a house, but the sources are usually difficult to locate.

Leaky pipes: Liquid wastes that leak out of drainage lines are not only annoying but a menace to health as well. Traps that are improperly attached may be the cause of such leakage. When a water-closet bowl is not sealed to the flange on the closet bend, leakage often results. Cast-iron pipe fittings may be cracked from strain if not properly installed or because of the settling of a building. Wrought-iron fittings can resist more strain and will bend before cracking or breaking. Strain on soil pipes may loosen joists. Portions of drainage pipe that have been subjected to strain from a frozen obstruction may be cracked and therefore should be examined if they are accessible.

Noisy drainage lines: Walls, ceilings and floors often act as sounding boards that transmit and magnify the noise of water rushing through drainage pipes. Such noise is especially likely to occur where a soil stack is in direct contact with the plaster base of a partition. About the only remedy is to open the partition and wrap the pipe with sound-deadening insulation such as mineral wool or hair felt. Where direct contact between the pipe and the plaster base is found, a slight clearance can be provided usually by cutting away some of the plaster base. Where excessive noise is traced to a water closet located over a living or dining room, the pipe is similarly treated, but then it is necessary to open the floor.

Painting soil pipe: The asphalt coating on soil pipe will bleed through any ordinary paint. To prevent this, the pipe must first be coated completely with aluminum paint, after wiping off all traces of oil or water. The pipe must be thoroughly dry before painting. When the aluminum paint has dried, any other type of paint can be used subsequently.

Draperies You Can Make

AS EMBLEMS of good taste and ingenuity, consider the advantages of draperies made from colored sheets. The obvious asset, of course, is that sheets are the most durable yet inexpensive of materials. Secondly, there is no piecing when you make draperies from sheets—no long seams and almost no hemming. Simply tear or cut a sheet lengthwise. Measure the window length, stitch on a heading, hem the torn edges and you have a finished pair of draperies ready to hang.

In one double-bed-size sheet, you can get about 7 yd. of smooth material that will fall into full, sculptured folds when hung as draperies. The wide hem can be utilized for a heading, with simple gathers, or professional pinch pleats can be made by using ready-made self-pleater bought by the yard.

Visualize the delightful effect you can create by decorating an entire room with colored sheets. Three double-bed-size sheets are enough to make a flounced



Fig. 1. Four double-bed-size sheets are trimmed with ball fringe to make this glamorous bedroom ensemble, which includes draperies, swag, vanity skirt, a single bedspread and vanity-seat cover

spread for a single bed, a pillow sham, a pair of window draperies, tie-backs and valance, and a full skirt for a vanity table.

Sheets also have a practical virtue in that they are easily laundered and can be starched to remain always crisp and fresh. Consider this feature in relation to the draperies of your dining room. Two complete table settings to match can be made from one double-bed-size sheet. There's material enough to make: One tablecloth, six tea napkins, plus four place mats, a runner and four small napkins.

For further harmony, sheets are wonderfully inexpensive for making quilted slip covers in line with the color scheme of your living room. (The underside can be made from older, more worn sheets.)

The simplicity of colored sheets provides an endless scope of decorating possibilities. Try combining other materials with colored sheets, such as, several rows of colored bias tape (Fig. 2), appliques cut from chintz, wide bands of contrasting rick-rack, or for interesting contrast, 5-in. bands of any lively, washable print like the plaid gingham in Fig. 3.

Sheets are readily adaptable to a variety of styling. For a Priscilla effect, add self-ruffles (Fig. 4) or ruffles made from dainty eyelet embroidery. The three-tier Provincial curtains in Fig. 2 can be made from

one sheet, and, as you'll notice, the bedspread is simply a single sheet with rounded corners plus a headboard made from a pillow case.

An important suggestion to remember when working with sheets is to allow for shrinkage in length in all your measurements. All sheets shrink about 5 percent, or 5 in. in length, although there is practically no shrinkage in width. Be sure to figure this in your measurements or, better yet, launder your sheets before cutting.

The double-bed-size sheet, 81 in. by 108 in., is the most practical for draperies and general decorating. But you should note that the length marked on the sheet or package as, for example, 108 in., is the length before hemming. The actual length of a sheet is 103 in. By ripping the hems before you start, you gain about 5 in. of extra material on each sheet. Also, by using pinking shears for hems, no turnunders are necessary. Simply turn up the desired width and stitch.

For a smoother and lighter drapery, you may find percale sheets more desirable, although, from a distance, it is difficult to detect the difference in texture, and muslin is less costly.

But don't stop at just making and trimming draperies—you can also hand-paint colored sheets or unbleached muslin. By

Fig. 2. Yellow sheets are edged with strips of red and green bias tape, matching headboard and curtains

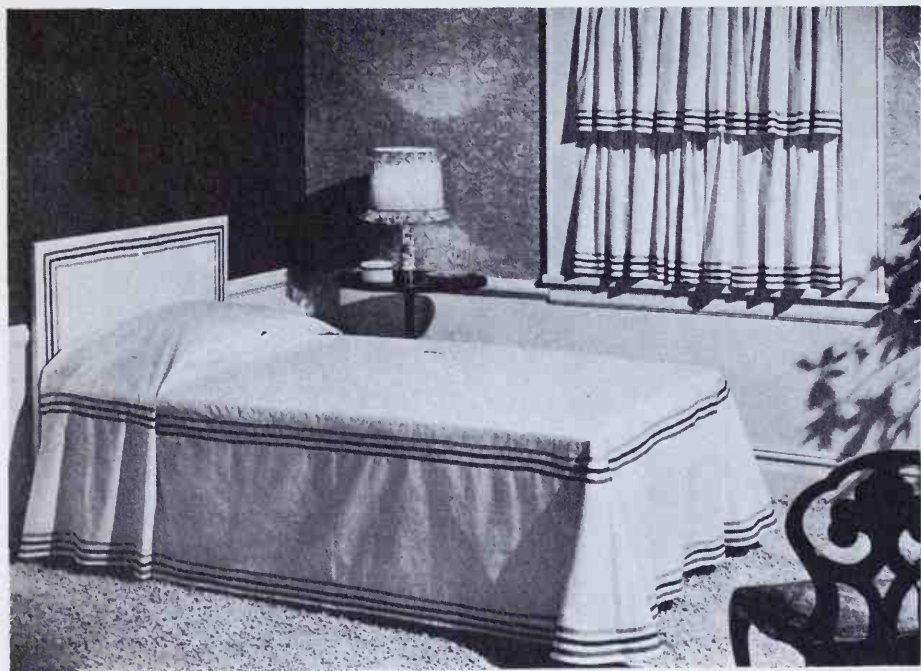




Fig. 3. The window drapes are sheets trimmed with 5-in. bands of plaid material matching couch cover

creating your own patterns, each room can be unique unto itself and in harmony with its setting—such as, animal sketches in the nursery (Fig. 5), soap bubbles for the bathroom, or an overlapping maze design as in Figs. 6 and 7 to develop a modern motif.

As previously suggested, the material should be soaked first for shrinkage, hung up to dry and then pressed with a hot iron. Textile paint can be used or oil paint plus an indelible mixture (Devon's) for a more pleasing color tone. In the latter case, the two ingredients should be mixed until the desired consistency and color are obtained. This is all a matter of experimenting and the colors should be tested on a trial piece of material before painting for some idea of the final results.

Mrs. Rhoda Tritschler, an artist who has

Fig. 4. Self-ruffles can be added to sheets easily

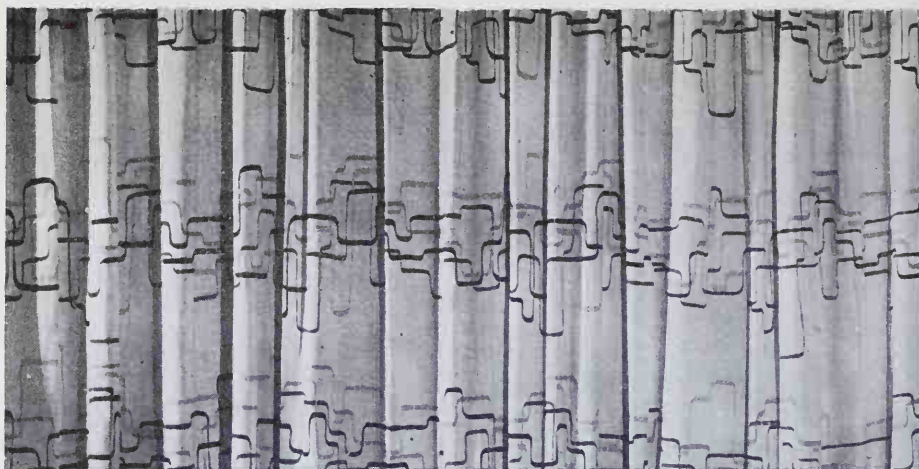


Fig. 5. Hand-painted designs, like the gay animals on these nursery drapes, give room true distinction

experience in painting her draperies suggests several methods you can apply. Probably the easiest and most common method is the use of stencils. To make your own stencils, draw on a piece of stencil paper the pattern you wish to reproduce, or copy the design directly by means of carbon paper, and cut around the lines with a stencil knife. The stencil paper and knife may be purchased at an artists' supply house or large department store. Wallpaper or magazines supply patterns that can be used.

After washing and ironing the material, stretch the cloth tightly on a drawing board or other suitable backing such as heavy cardboard that will not buckle or allow the fabric to wrinkle, and fasten the cloth with tape or thumbtacks. Put the stencil over the area you wish to color and fasten it in place with pins or thumbtacks so that it cannot move out of place. Also, be sure that the edges of the stencil are pressed tightly to the cloth, otherwise the color will seep under them and blur the outline. Apply the color with a stencil brush, using light, sweeping strokes. It is better to apply several light coats than it is to put on a single thick one. The amount of paint used on the brush is an important factor. If a consistent pattern is desired, a consistent amount of paint should be used on the brush. Too much paint will blur and too little will tend to give a light, possibly faded-out appearance. This should be determined on the trial piece of cloth before actual painting.

Work the color into the fabric, occasionally stippling with the end of the brush to obtain a uniform penetration. Then remove



Maze design can cover whole area as in Fig. 6 (above) or be simple color band as in Fig. 7 (below)

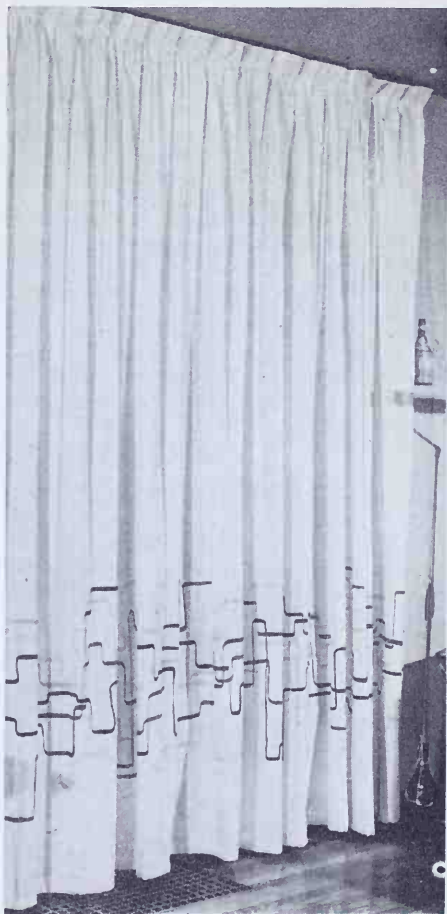
the stencil carefully, taking care not to let any part of it come in contact with the wet color to streak it.

Another method is to carve a pattern out of a block of linoleum. Follow the above directions in stretching the cloth tightly over a backing, dip the block into the paint and then place it firmly on the fabric. To imprint the pattern evenly, apply pressure on the block with your hand.

If you decide to paint free-hand, you should work out a definite pattern before working on the fabric. Paint the design on a long sheet of paper which can be tacked up on the wall to be copied.

Whichever of the above methods is used, some process will be needed to set the paint so the cloth can be cleaned later without danger of washing out the paint or smearing the design. Mrs. Tritschler suggests setting the pattern by pressing it with a hot iron. Before setting the paint, allow the work to dry thoroughly for about 48 hrs., more or less, depending on the fabric and the amount of paint used. Place a damp cloth over the back of the design and iron it for at least a full minute with the iron heat at 350 deg. By dampening the pressing cloth with white vinegar instead of water you will increase the "fastness" of the color.

An added suggestion to follow during any of the above painting processes is to put an absorbent material, such as a towel or newspaper, under the area being painted, so the excess paint will be soaked up. The paint will have less tendency to run and smear if the absorbent material is present.



DRAWING BENCH



MATERIAL LIST

Clear Lumber

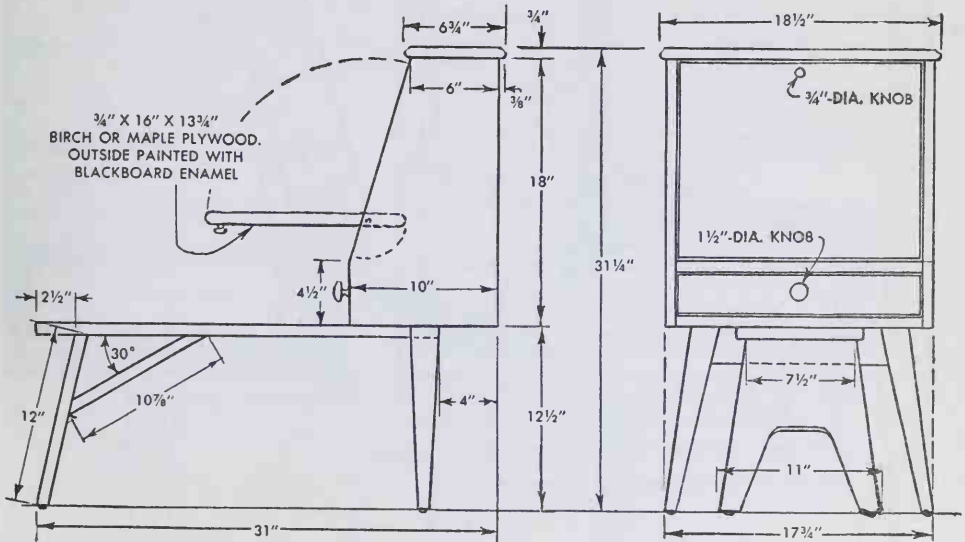
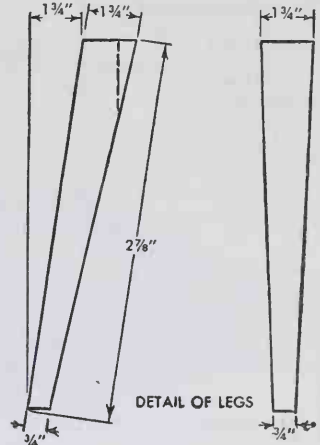
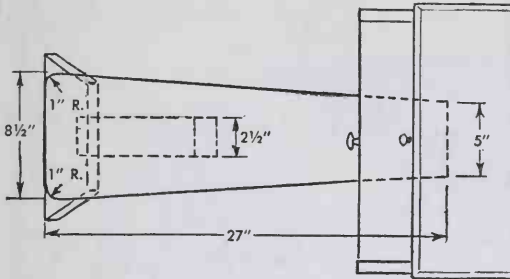
- 1 pc.— $\frac{3}{4}$ " x $6\frac{3}{4}$ " x $18\frac{1}{2}$ "—Top
- 2 pcs.— $\frac{3}{4}$ " x $10\frac{1}{2}$ " x $18\frac{1}{2}$ "—Sides
- 1 pc.— $\frac{3}{4}$ " x $8\frac{1}{2}$ " x $25\frac{1}{2}$ "—Bench seat
- 1 pc.— $\frac{3}{4}$ " x $11\frac{1}{2}$ " x $12\frac{1}{2}$ "—Bench end
- 1 pc.— $\frac{3}{4}$ " x $2\frac{1}{2}$ " x $10\frac{1}{2}$ "—Brace
- 2 pcs.— $\frac{3}{4}$ " x $1\frac{1}{4}$ " x $12\frac{1}{8}$ "—Legs
- 1 pc.— $\frac{3}{4}$ " x $2\frac{1}{2}$ " x $11\frac{1}{8}$ "—Leg cross brace
- 1 pc.— $\frac{3}{4}$ " x $7\frac{5}{8}$ " x $16\frac{7}{8}$ "—Shelf
- 2 pcs.— $\frac{3}{4}$ " x $9\frac{3}{4}$ " x $16\frac{7}{8}$ "—Shelves
- 1 pc.— $\frac{1}{2}$ " x $2\frac{1}{2}$ " x $16\frac{7}{8}$ "—Shelf
- 1 pc.— $\frac{1}{2}$ " x $1\frac{1}{2}$ " x $16\frac{7}{8}$ "—Rail
- 2 pcs.— $\frac{1}{2}$ " x $3\frac{1}{2}$ " x $10\frac{1}{2}$ "—Side stops
- 1 pc.— $\frac{3}{4}$ " x $2\frac{1}{2}$ " x $16\frac{1}{2}$ "—Drawer front
- 2 pcs.— $\frac{1}{2}$ " x $2\frac{1}{2}$ " x $9\frac{3}{4}$ "—Drawer sides
- 1 pc.— $\frac{1}{2}$ " x $2\frac{1}{2}$ " x $15\frac{3}{8}$ "—Drawer back
- 1 pc.— $\frac{3}{4}$ " x $3\frac{1}{4}$ " x $16\frac{1}{4}$ "—Cleave

Hardboard

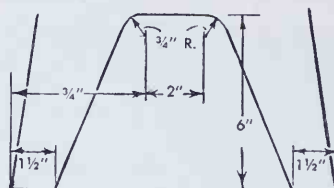
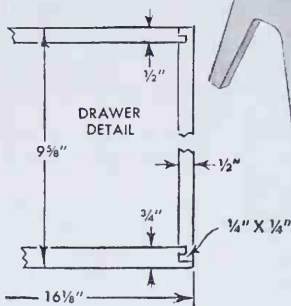
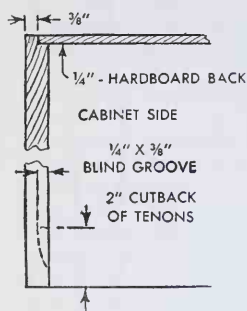
- 1 pc.— $\frac{1}{4}$ " x $9\frac{1}{2}$ " x $15\frac{3}{8}$ "—Drawer bottom
- 1 pc.— $\frac{1}{4}$ " x $17\frac{1}{2}$ " x $15\frac{3}{8}$ "—Back

Birch Plywood

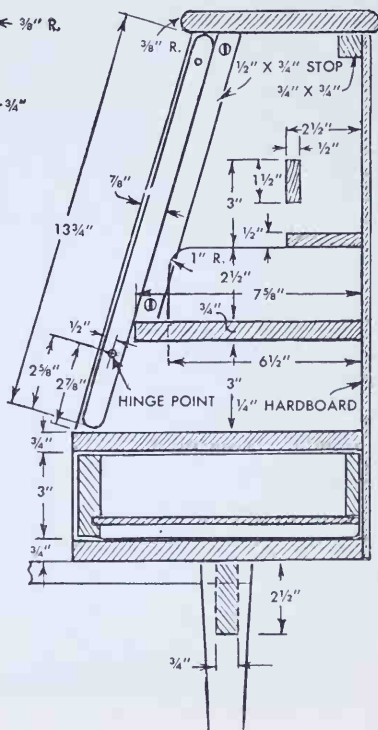
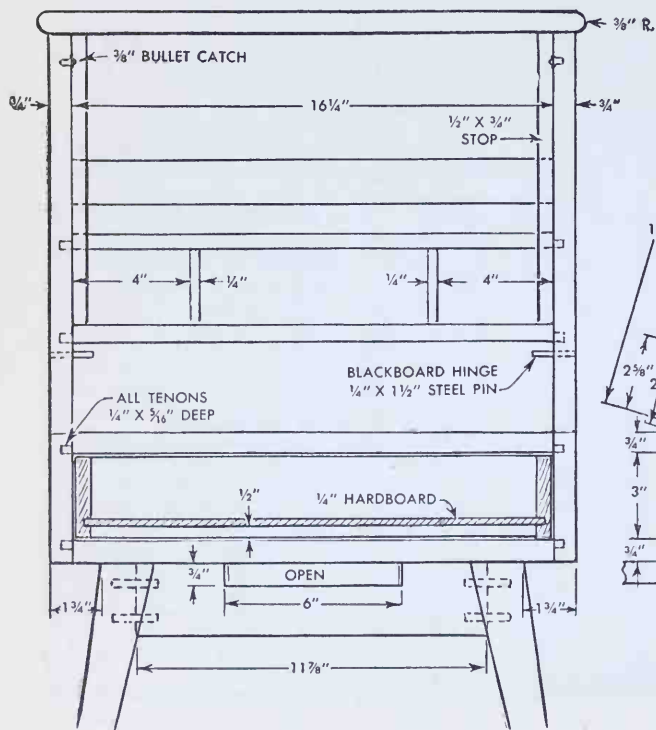
- 2 pcs.— $\frac{3}{4}$ " x $2\frac{1}{2}$ " x $6\frac{1}{2}$ "—Dividers
- 1 pc.— $\frac{3}{4}$ " x $16\frac{1}{2}$ " x $13\frac{3}{4}$ "—Blackboard



The child who likes to play with chalk, crayons and water colors will spend many happy hours at this "sawhorse" drawing bench. The hinged desk front is coated with blackboard enamel to provide a large drawing surface when closed. When opened, the front forms a desk top and discloses a handy storage rack for paper and coloring books as well as three compartments for drawing materials. A drawer for odds and ends is installed directly beneath the desk top. Note that the cross brace which is fitted between the splayed legs of the desk unit is notched to take the end of the bench seat. The latter is inserted in the notch and fastened with glue and screws to the underside of the desk after the bench endpiece and brace have been assembled

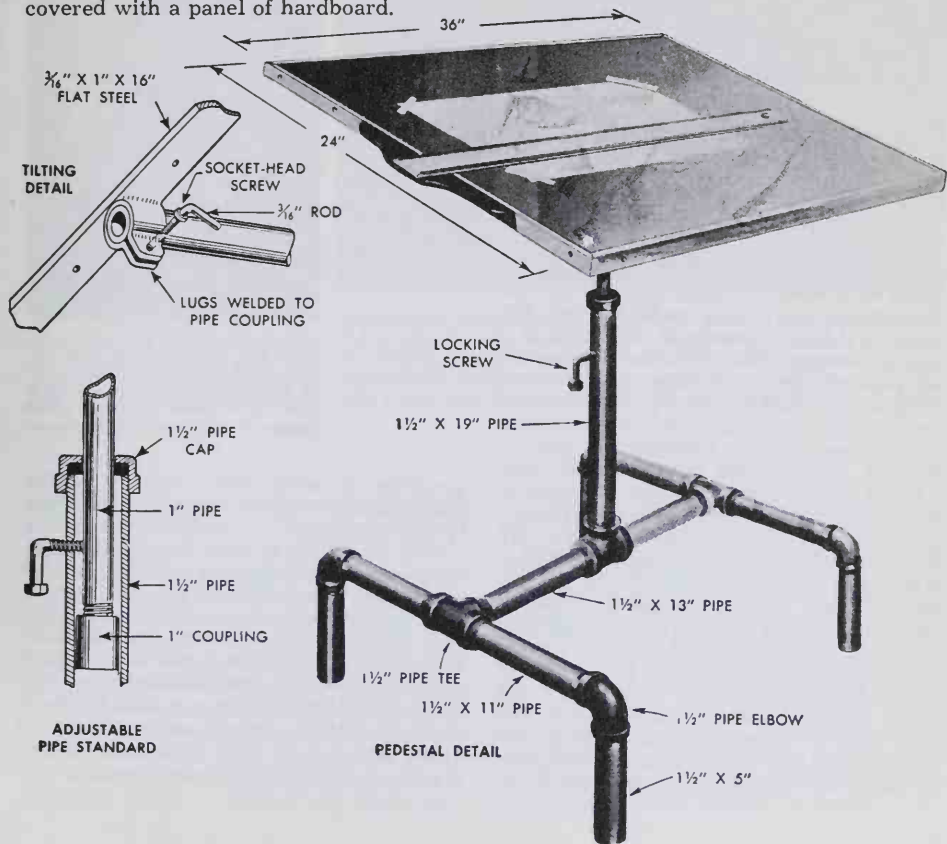
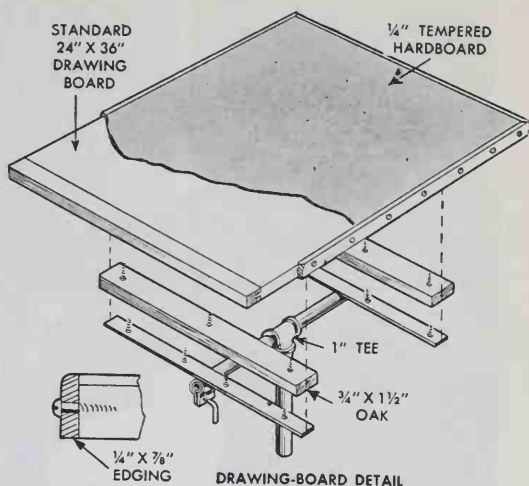


DETAIL OF BENCH END



DRAWING BOARD

FEATURING a husky, adjustable pedestal assembled from pipe and fittings, this homemade drawing board has the necessary sturdiness to make it ideal for general layout work in the shop. Utilizing a standard 24x36-in. drawing board which is attached to a split-coupling tilting mechanism, the large top may be conveniently locked at any desired angle by two L-bolts. The sectional detail below shows how the 1-in. pipe that supports the drawing board is fitted with a coupling to slide inside the pedestal. It may be necessary to file or machine the coupling to provide a smooth sliding fit. A pipe cap fitted to the top of the pedestal is used to center the pipe in the column. The friction tilting arrangement consists of two split couplings welded to lengths of flat steel. Lugs are welded to each coupling and then drilled for a locking bolt. The latter is made by brazing a $\frac{3}{16}$ -in. rod in the end of a socket-head setscrew, and only one leg of each lug is tapped for the locking bolt. The top of the board may be covered with a panel of hardboard.



DRIED FLOWERS



Goldenrod makes a beautiful and lasting bouquet. This was gathered in mid-winter, dried and sprayed with a flat-type paint. You'll find pastel shades give the best results



Large seed pods of American water lotus and Yancopin, gilded, can be used to form the predominant part of a winter bouquet when combined with bushy-type grasses

There's money in making and selling artificial bouquets and it's practically all profit, too, for they can be made of dried flowers, grass or even weeds and decorated with dime-store paint

DRIED AND SPRAYED or painted by hand in a riot of colors, common garden flowers and even lowly roadside weeds become a thing of beauty in the form of a winter bouquet. The best flowers for this purpose are the everlastings as they are of a papery, strawlike quality and when dried retain their shape and color exceptionally well. These include helichrysum (straw-flower), cantananche (Cupid's dart) and winged everlastings. Others frequently grown in average gardens are sea lavender, globe amaranth and babies'-breath. To prepare everlastings for bouquet material, pick them when the flowers first open from the bud and hang them upside down in small bunches in a warm room, after first stripping off the leaves. Let them remain until the heat has drawn the last vestige of moisture from the stems. If you wish, the stems can be removed and replaced with ones of wire. Wire stems will permit forming sprays and other unusual arrangements. The bouquet is preserved by

spraying it with clear lacquer which brightens the original colors and gives the bouquet stiffness.

You don't need to stick to flowers alone. Many attractive bouquets can be made up of berries, seed pods and grasses. As for berries, there are those of the bittersweet vine, barberries, Indian currants, coralberries, etc. The hard seed pods of larkspur, primrose, tulip tree and mallow, as well as the globular heads of poppy plants, all lend themselves to forming attractive bouquets. There are also the pods of okra and dried tassel of corn. Roadside weeds, such as the



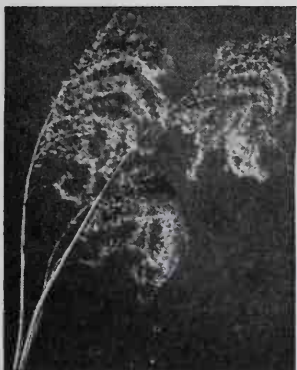
Burr grass, a rough grass, is ideal for winter bouquets. It can be left its natural color and sprayed with clear lacquer to preserve it, or colored by spraying it with paint



Flowers of the helichrysum plant (strawflowers) when dried retain their shape and colors almost indefinitely. Stems usually are removed and replaced with wire



A bouquet combining plume grass with cattails. The grass must be sprayed with thin lacquer to prevent shedding the seed, while the cattails are dipped in collodion



Here's what plume grass, a cultivated grass, looks like when used by itself in a bouquet. This, like pampas grass, must be sprayed with lacquer to prevent shedding



Seed pods of a rhododendron bush when painted pink or orchid color in contrast with its glossy green leaves make a striking bouquet to add a decorative touch to a room



Seed pods entirely make up this bouquet. It combines those of milkweed, wild primrose and mallow. Pods are painted various colors to contrast with green stems

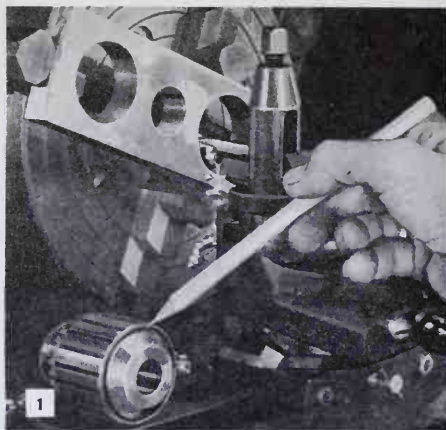
Jimson, milkweed, primrose and many others, are suitable, too. Bouquets of these materials usually are painted with quick-drying paint or enamel, painting the pods in various colors and the stems green.

There are a number of grasses that will do. Plume grass and pampas grass are very good. A variety called sea oats, a tall grass with oatlike panicles, is used commercially. Cattails also are popular in winter bouquets, but like grasses, they have light downy seeds that shed very easily. These can be made nonshedding by coating with collodion cement. Grasses are made non-

shedding by spraying them uniformly with thin, clear lacquer or white shellac.

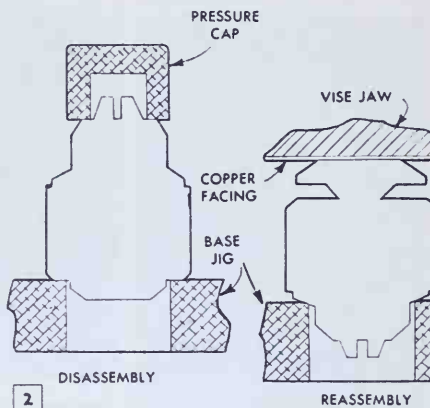
The accompanying photos show a few of the many combinations of seed pods, flowers and weeds that can be used. An unusual bouquet which is appropriate at Christmas time can be made from a few ordinary tree branches and twigs. These are first painted red or white and then dusted with mica-type artificial snow while the paint is still wet. A rhododendron branch with its flowerlike seed pods forms a novel bouquet when the pods are painted pink or orchid and the leaves green.

DRILL CHUCK SERVICING



For disassembling and assembling geared drill chucks, a pressure plate, shown in lathe chuck, is necessary. Holes in plate are bored a little larger than chuck body

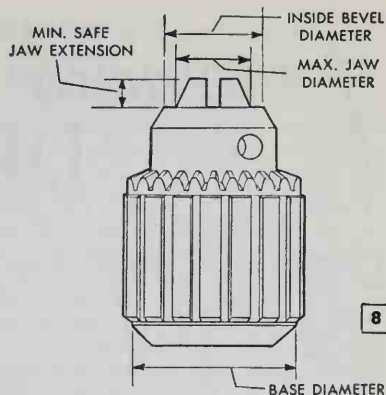
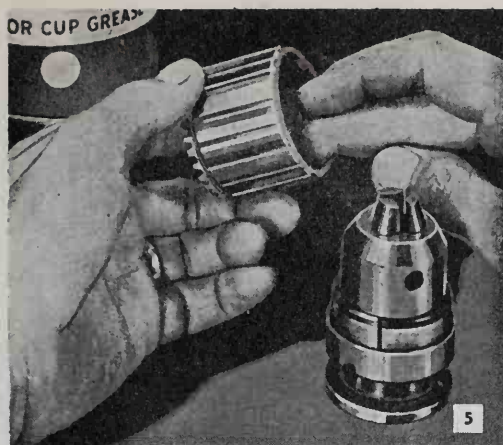
AFTER long periods of hard service, geared chucks on all-purpose units, such as portable electric drills and small drill presses, become clogged with an accumulation of wood and metal chips, dust, and abrasive grit which impairs the accuracy of the chuck and may even cause serious damage. Often a thorough cleaning of the chuck will restore its accuracy and save the cost of replacement. Disassembly of a geared chuck is simple when you use a two-piece jig like that shown in Figs. 2 and 6. The jig consists of a pressure plate and cap and the two members are combined in the disassembly and reassembly of the chuck as in Fig. 2, using an ordinary bench vise as a means of applying pressure as in Figs. 3 and 7. The pressure plate and cap detailed in Fig. 6 are designed to accommodate several sizes of geared chucks, but



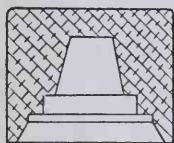
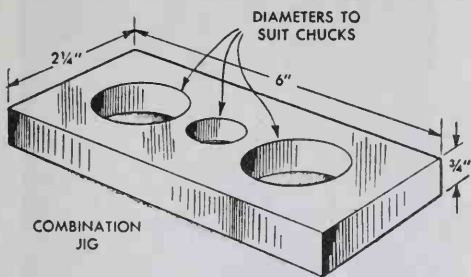
Disassembling jig consists of pressure plate and cap which are placed in vise with chuck between. Closing vise jaws forces the geared sleeve off the chuck body



Clean all parts of the disassembled chuck in a clean solvent, using an old toothbrush to loosen accumulations of dirt and hardened grease from moving parts

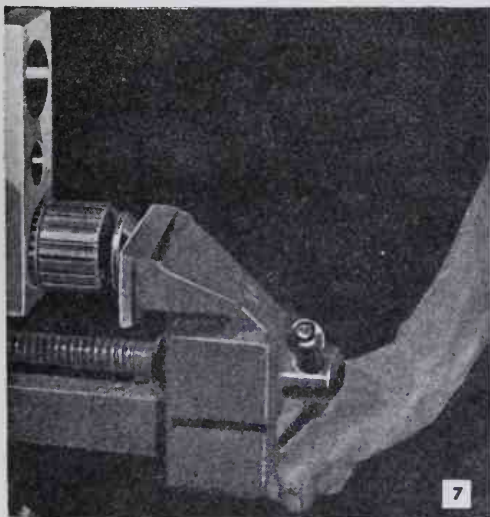


CHECK THESE DIM. BEFORE MAKING JIG



COMBINATION CAP
FOR DISASSEMBLY

6



7

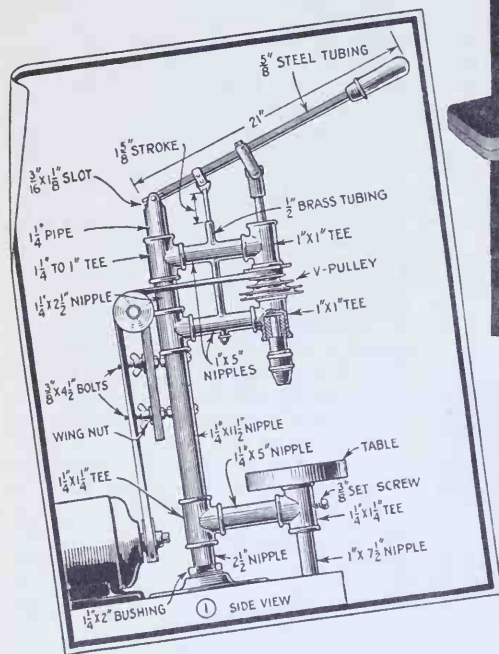
also can be made as separate units for each individual chuck, if desired. The units pictured were made from machining aluminum alloy, the pressure plate being set up in the lathe and bored as in Fig. 1. Before finishing the bores, check the measurements of the individual chucks at the points shown in Fig. 8, and then bore the plate and cap accordingly. Ordinarily, the holes bored in the plate should be about .005 in. larger than the diameter of the chuck body as measured just above the top end of the geared sleeve, Fig. 1.

To disassemble the chuck, first detach it from the tapered spindle and run the jaws either in or out so that they are just slightly more than half closed. This is important, as otherwise the teeth on the upper ends of the jaws may not fully clear the sleeve and damage can result when the sleeve is forced off. Now, set up the jig and chuck as in Fig. 3 and tighten the vise jaws slowly until the geared sleeve is released. This exposes the chuck body so that the hardened split ring and jaws may be removed. Wash all parts thoroughly in a clean solvent, using an old toothbrush to remove hardened grease and accumulations of dirt and grit. Handle all parts carefully and take special precautions to avoid dropping them on the floor. In reassembling, after cleaning and relubricating as in Fig. 5, be sure to replace all parts in the same order and in their proper positions. Then place the pressure plate and chuck in the vise as in Fig. 7 and force the sleeve slowly back into position on the chuck body. In this operation it is advisable to use a soft-metal facing on the vise jaws to avoid burring the tapered hole in the chuck body. It should be noted that some special types of geared chucks are fitted with ball bearings and it is not recommended that these be disassembled in the manner described.

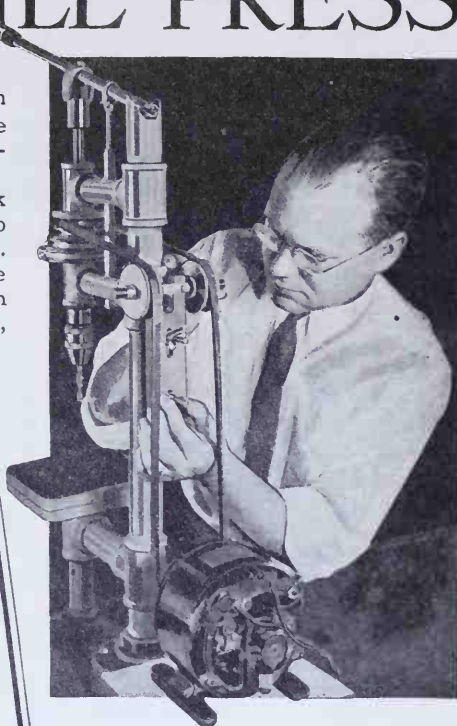
Homemade Ball-Bearing DRILL PRESS

CONSTRUCTED almost entirely from pipe fittings, this drill press will be found exceptionally rigid, neat in appearance and quiet in operation.

First get a cone pulley having a thick hub to allow a slot for the key. Refer to Figs. 1 and 6, and construct the frame. Drill through for the spring-assembly tube before screwing on the table support. Bush the 1-in. tees with 1-in. pipe as shown,



cut off and carefully drive in model-T Ford spindle bushings after having reamed to fit $\frac{1}{2}$ -in. drill rod. Insert the shaft and align the bearings by tapping the shaft. With the shaft in place, pour molten bab-bitt around the spindle bushings. Now fasten a pulley on the shaft, take up the end play with a shaft collar, place it under



power and turn down a groove as shown in Fig. 3. The long slot is cut easily with a plane made of two hack-saw blades clamped between two thin boards and a third board extending below to guide against the shaft. Make a key to fit this slot as in Fig. 4, and drive it into a slot cut in the top of the pulley. The upper pulley grease retainer is made by cementing a $\frac{1}{16}$ -in. aluminum disk to the pulley. Allow 24 hours for drying and then cement a $\frac{1}{4}$ -in. plywood ring to the disk. Turn this true and cement the upper disk, which is cut out to clear the tee. Turn the whole assembly true with a file. The lower grease retainer is simply a brass cup, Fig. 2, made by wiring sheet brass around a $\frac{3}{4}$ -in. pipe and soldering

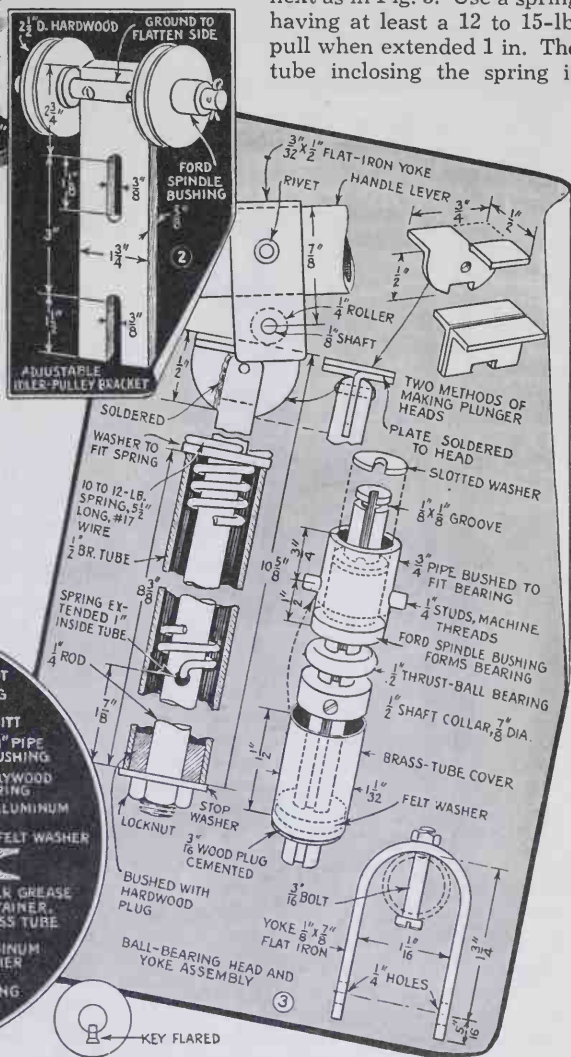


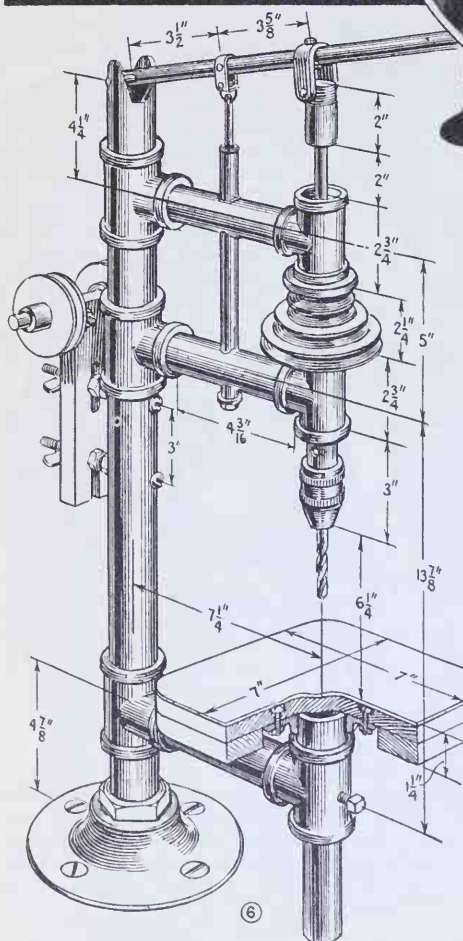
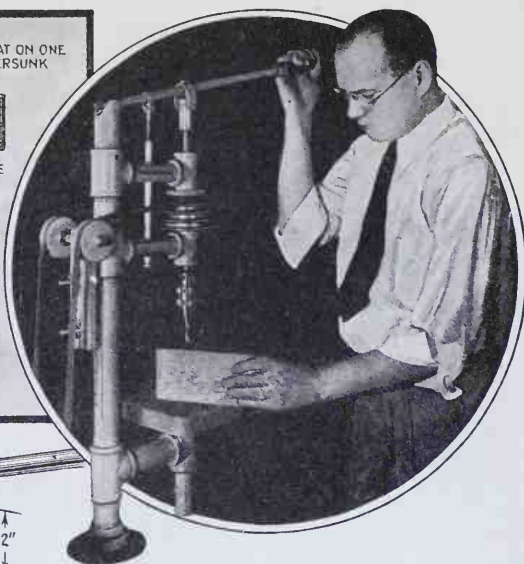
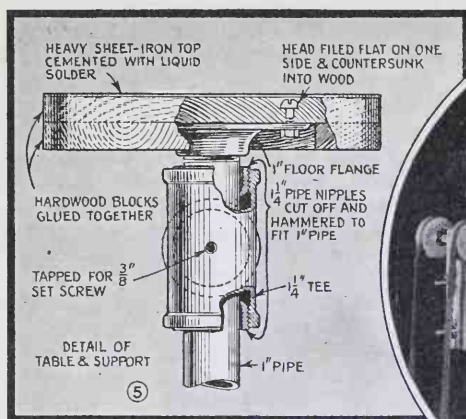
bearing grease retainer assembly as shown. The cover slides to a tight fit on the $\frac{3}{4}$ -in. pipe. Cut off a Ford spindle bushing and drive it into the $\frac{3}{4}$ -in. pipe after bushing with split tubing or tin. Drill through and tap for $\frac{1}{4}$ -in. studs. The studs must have cut threads to avoid turning through into the shaft. See that all pivoting points in the handle lever are in alignment by inserting long rods in the holes and sighting along these. If not lined up properly the top bearing will heat up rapidly.

Construct the spring plunger assembly next as in Fig. 3. Use a spring having at least a 12 to 15-lb. pull when extended 1 in. The tube inclosing the spring is

the joints. Cement a wood plug in the bottom as shown. Make a large aluminum washer to support the lower ball-bearing assembly.

To assemble the shaft, drop the lower ball-bearing cup down into the tee and slide the pulley in place. Raise the grease retainer cup into place and slide the washer beneath. Then insert the shaft upward through the pulley. Refer to Fig. 3 to make the upper ball-

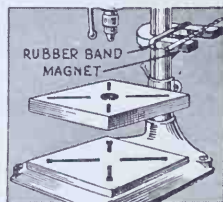




soldered to the frame as in Fig. 1. This arrangement relieves the upper bearing of strain, allowing high speeds. Refer to Fig. 2 and construct the bracket as shown using two 3/8-in. bolts to support it. Drive a spindle bushing through a hole in a hardwood block and turn it to the dimensions shown. Wing nuts and lock nuts hold the bracket firmly in the desired position, providing for belt adjustment. The table is made as shown in Fig. 5. Level it square with the shaft by bending the malleable tee slightly, with blows of the hammer. Use a well-made chuck having a short overhang. A standard 58-in. V-belt is used.

Magnet Used as Drill Holder

One of the handiest holders for drills at a drill press is a large magnet taken from an old magneto. The magnet fits around the drill-press standard, and a rubber band from an old inner tube holds it securely at any desired height.

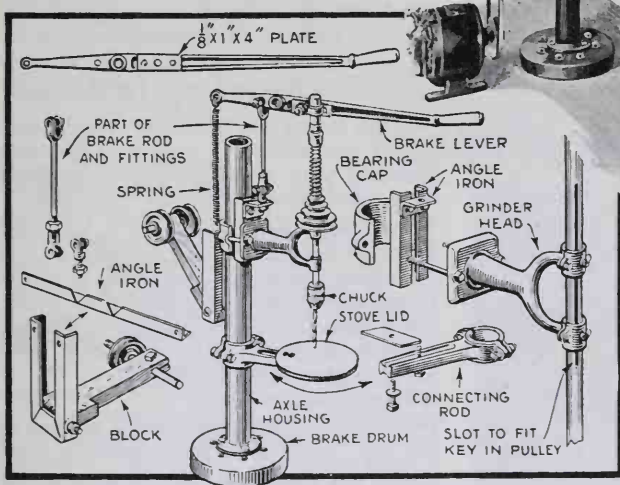


DRILLPRESS

from Auto Parts

DRIVEN by means of a $\frac{1}{4}$ -hp. electric motor, this homemade drillpress, built mostly from old auto parts and a few items obtainable from your local dollar store, is sturdy, accurate and smooth in operation.

A cut-off portion from an axle housing is bolted to a brake drum, which, in turn, is bolted to the bench top. The spindle bearing is a small grinder head and is



clamped to the housing by means of two lengths of angle iron and a connecting-rod bearing cap, as shown in the detail. A groove is milled in the spindle to take a key of a step pulley, permitting the spindle to be raised and lowered while the pulley is rotating. The drillpress table consists of a stove lid bolted to a connecting rod, which is clamped to the axle housing. An old brake lever provides a convenient handle, being attached to the upper end of the spindle and pivoted directly above the base of the grinder head, part of a brake rod and fittings being used for this purpose. A coil spring, attached to the end of the handle and to the assembly below, keeps the spindle up when not in use. Two small V-pulleys are slipped on a short piece of drill rod, which is held in a wooden block that

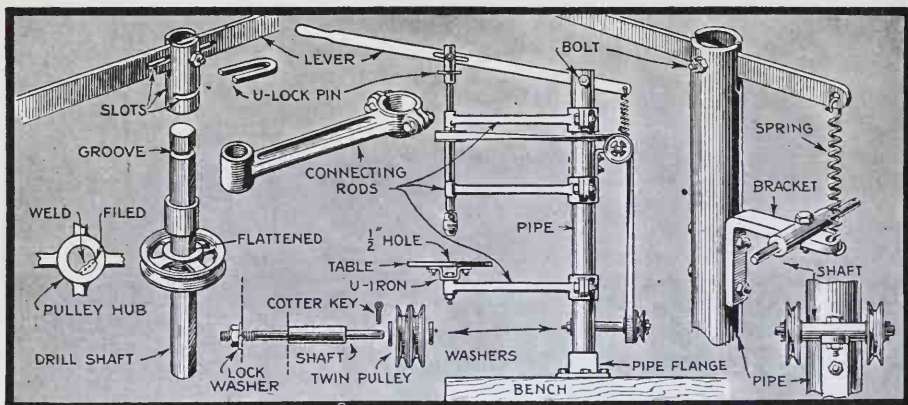


is pivoted in an angle-iron frame attached to the axle housing as shown. The lower end of the spindle is threaded for a suitable chuck, which must be purchased.

Another design for a drillpress made from auto parts is also given. In this case, a pipe flange is substituted for the brake

drum and a length of pipe for the axle housing. Two connecting rods are used instead of the grinder head, to provide a double head for the spindle. Also, the lever is pivoted in a slot at the top of the pipe frame. Other points of difference in the construction and assembly can be gathered from the illustrations.

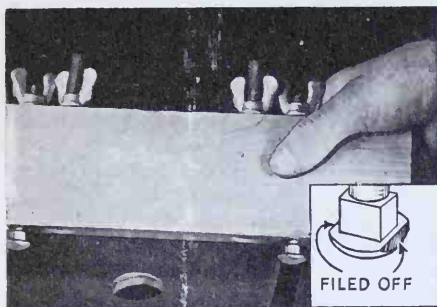
To operate such a drillpress you will need an electric motor of $\frac{1}{4}$ hp. If you have an old electric motor of the type used on a washing machine or can readily obtain one, the drillpress will involve very little expense. For a chuck it is best to get one of the better known and well-made brands, as a great deal of the accuracy of a drillpress depends on the chuck. One up to $\frac{1}{2}$ in. capacity is suggested. You can use a two-belt drive or belt the drillpress



direct to the motor. In either case it is advisable to use a three-step pulley on the motor to provide speed adjustment. Ac-

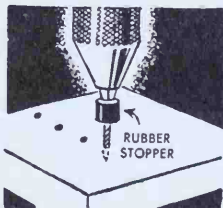
Drill-Press Fence Removed Quickly

Less time will be spent attaching or removing the fence on a drill-press table if the sides of the carriage-bolt heads are filed off as indicated in the lower right-hand detail. When the straight sides are turned to parallel the slots in the table, the fence can be removed without screwing off the wing nuts.



Stop on Drill Prevents Damage

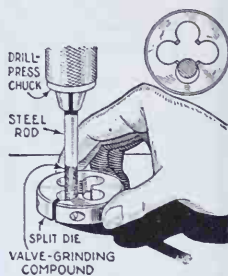
Users of push drills find that unless extreme care is exercised, the drill will break through and mar finished work. To prevent this, one craftsman slips a rubber stopper over the shank of the drill which cushions the shock when the point breaks through.



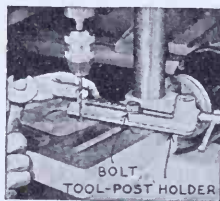
cessories such as the V-pulleys, belts and chuck can be obtained from almost any dealer of home workshop supplies.

Dies Sharpened on a Drill Press

I have found the simple method illustrated very effective in sharpening small dies. To do this, a steel rod slightly smaller in diameter than the holes in the die is chucked in a drill press, which is then turned on, valve grinding compound being applied to the rod. I take each hole separately, first on the starting-thread side of the die and then on the finishing-thread side, applying a little more compound as I proceed.



Work Clamped on Drill Press by Lathe Tool-Post Holder

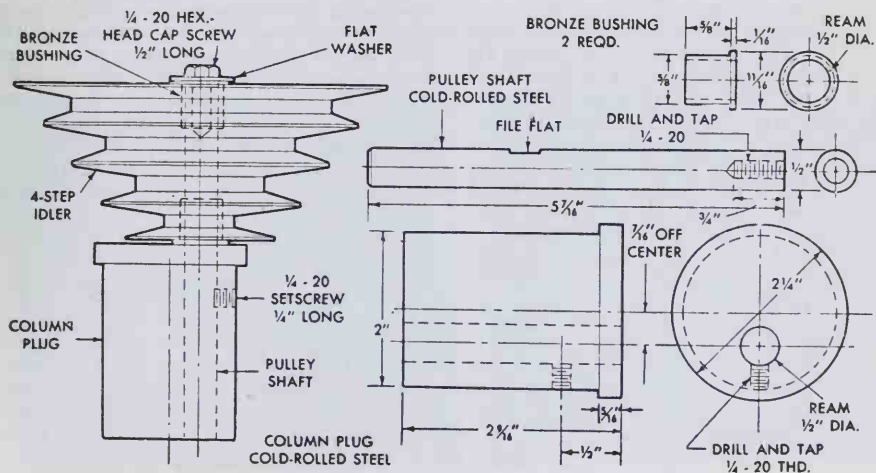
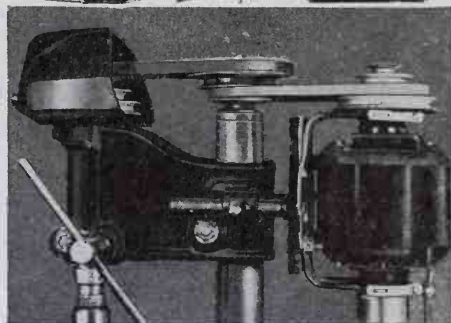
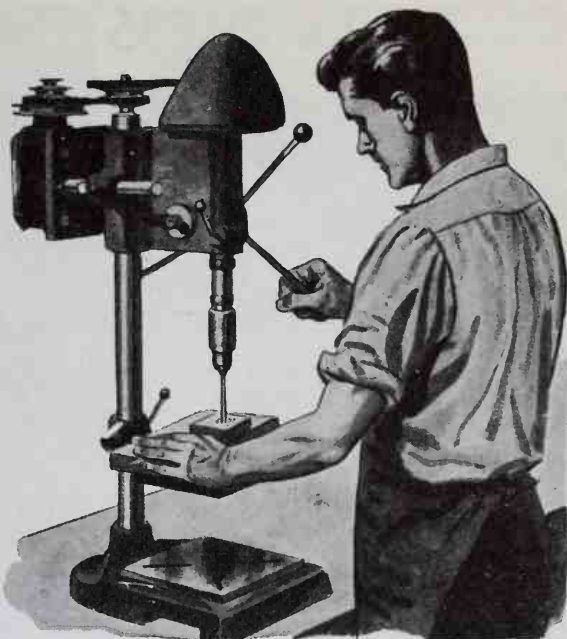


The tool-post holder of your wood-turning lathe will be found handy for clamping work to the table of a drill press. A bolt passing through the assembly in place. To level the clamp with the work, a piece of wood the same thickness should be placed under the clamp.

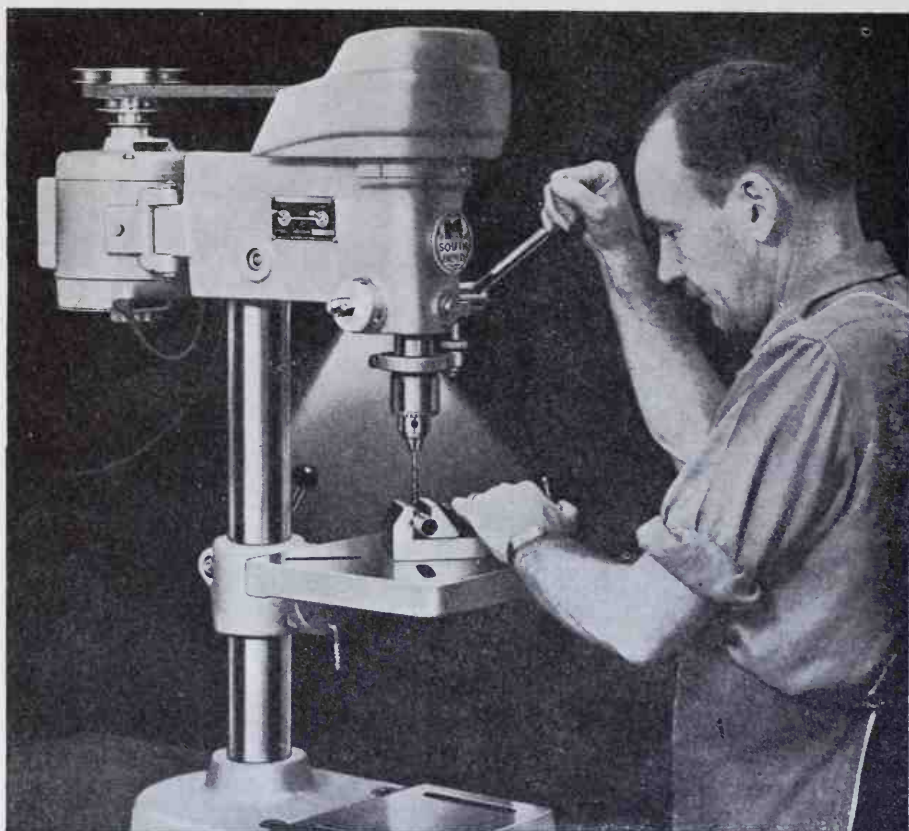
DRILL-PRESS SPEED ATTACHMENT

DESIGNED to fit in the tubular column of your drill press, this speed-change attachment permits a greater range of speeds than is possible with the conventional drive. Adding a third pulley and replacing the original belt with two short ones provides a jackshaft which makes possible pulley combinations resulting in speeds ranging from a low of 200 r.p.m. on up to very high spindle speeds suitable for routing. The stepped pulley on the motor is inverted from its normal position, and the offset mounting of the idler pulley permits belt takeup.

Turn the column plug in the lathe to an easy push fit in the column of your drill press, leaving a $\frac{5}{16}$ -in. collar on one end. Face both ends square and drill and ream the $\frac{1}{2}$ -in. hole $\frac{7}{16}$ in. off center for the pulley shaft, as indicated in the detail. Cross-drill and tap a $\frac{1}{4}$ -20 hole for a set-screw for locking the shaft in position. Make the bushings from bronze rod and machine the outer diameter to a firm, push fit in the pulley hole. Ream to exactly $\frac{1}{2}$ -in. diameter after the bushings have been pressed into the pulley. The pulley shaft is drilled and tapped for a $\frac{1}{4}$ -20 cap screw.

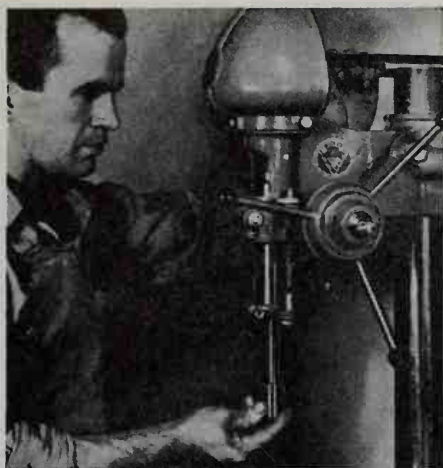


DRILL PRESS TECHNIQUE

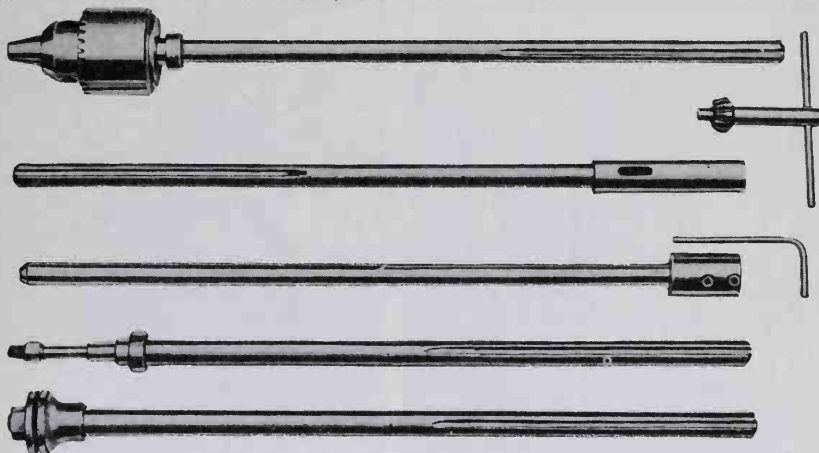


ONE OF THE MOST VERSATILE power tools in the small shop is the drill press. It makes no difference whether the machine is of the bench or floor type, large or small, it still has about the same range of all-around utility. In the homeshop the light drill press doubles as a high-speed boring machine for woodworking, a delicate precision unit for drilling accurate pin-sized holes in model parts, a high-speed router, a hollow-chisel mortising machine, a surface planer, surface grinder, shaper, and so on through a long list of special applications. If you do anything approaching diversified work in your homeshop you just can't get along without a drill press for both metal and wood working. Along with the lathe and the scrollsaw, it's one of the more quiet machines, in fact, in slow-speed operations it makes somewhat less noise than an electric sewing machine.

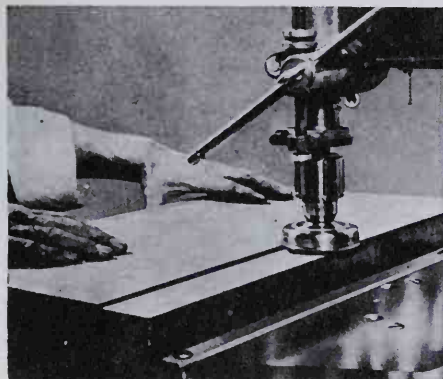
Types and sizes: It's well to give a little thought to the choice of the size and type of machine you need. A good drill press will last a long, long time, so make sure you get the tool best suited to your needs. An 11-in. machine rates small, even for homeshop use, while a 17-in. press would be large for most workshop applications. The 15-in. size is just right for 90 percent of the jobs you'll find for it. The size rating in inches means simply that the machine designated as "15-in." size will work to the center of a 15-in. circle, or, in other words, the clearance between the center of the chuck and the column is about 7½ in. The bench-type machine pictured above is typical of the offerings of various manufacturers which are suitable for homeshop use. It also is supplied, as are nearly all others in this size range, in a floor model. If you're a little cramped for space, or if you don't have



Many small drill presses can be fitted with a number of interchangeable spindles like those pictured below. It takes only a minute or so to interchange spindles

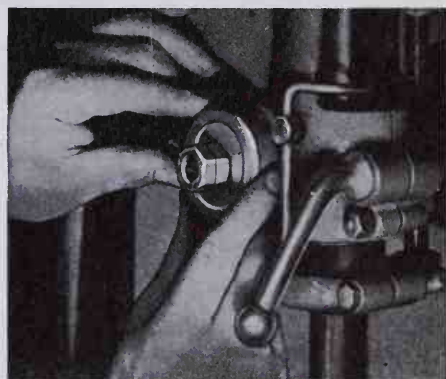


Can't do planing on a drill press? Take a look at the lower left-hand photo. Here's one doing a first-class job with a special rotary planing head available as an accessory. This operation is better referred to as surfacing, but call it planing if you like. Lower-right photo shows how to set the spindle return spring



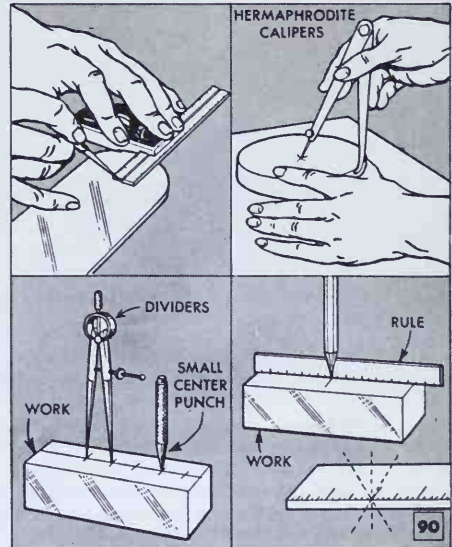
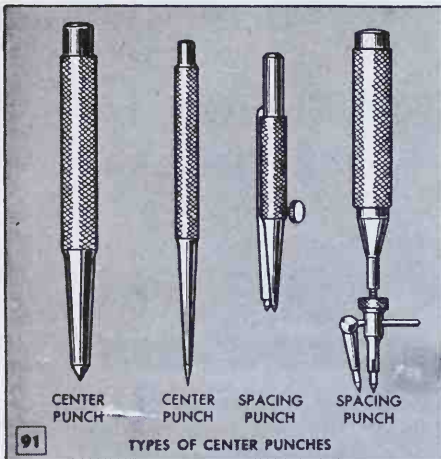
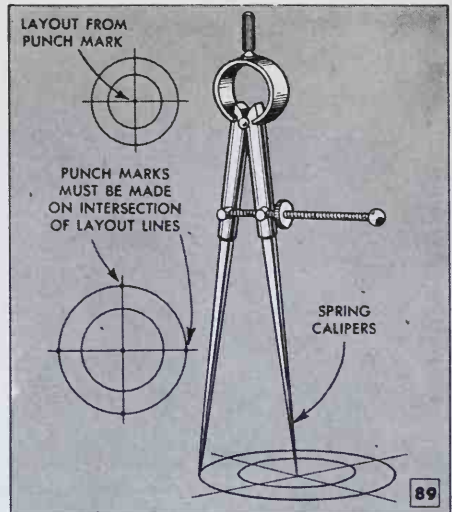
much bench-top room available, then the floor model is likely the best all-around choice.

Interchangeable drill-press spindles: Several of the small machines are adapted to use interchangeable spindles. An assortment of spindles for various types of work is pictured below to give you an idea of what is available. Reading top to bottom, the first spindle pictured comes with the chuck attached and is the one commonly furnished with the machine. The second one is furnished on order in lieu of the first. It has a hollow sleeve taper-bored for use with drill bits having tapered shanks. It is used where extreme accuracy is required. The third, also supplied as an accessory, has a straight sleeve, usually of $\frac{1}{2}$ -in. internal diameter, with two hollow setscrews. It will take any drill-press accessory having a $\frac{1}{2}$ -in.-diameter straight shank. The fourth is a shaper spindle having a long shank on which shaper cutters and rubbing collars can be mounted in almost any combination

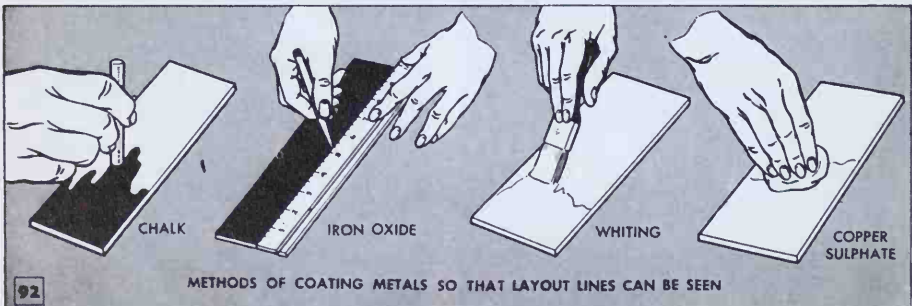


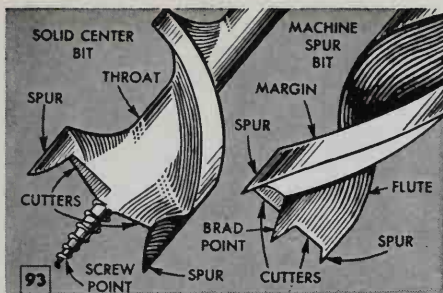
desired. The last spindle is fitted with one fixed and one movable collar, and is especially made for cup-type grinding wheels, although the straight grinding wheel or a buffing wheel also can be used.

Laying out drill-press jobs: Figs. 89 to 92 inclusive show the various types of measuring tools, center punches and layout methods used in locating and center-punching holes, scribing, and coating the metals so that the layout marks and punch marks are easily seen. In addition to the types of center and spacing punches shown, there is an automatic punch available in various sizes. Just set the point of the punch on the intersection of the layout lines and press down—hard. A tiny spring-actuated hammer housed in the punch handle drives the point neatly. Dividers, steel rules and calipers will come to be familiar tools as you progress in drill-press work in metals. With the possible exception of the center punches and, of course, the metal coaters, nearly all the tools pictured are used in woodworking when it is necessary to lay out the work for drilling.

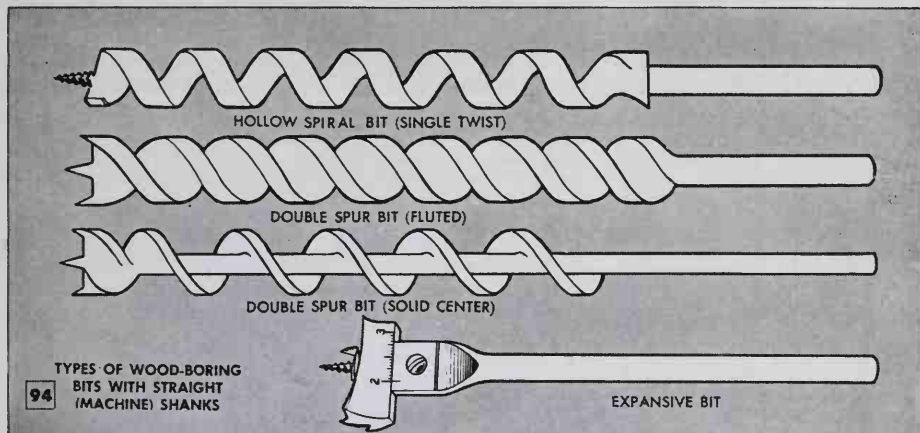


These are the measuring tools you'll use in laying out work for drilling in wood and metal. Metals are coated in various ways as shown below so that the layout marks can be seen clearly for center-punching

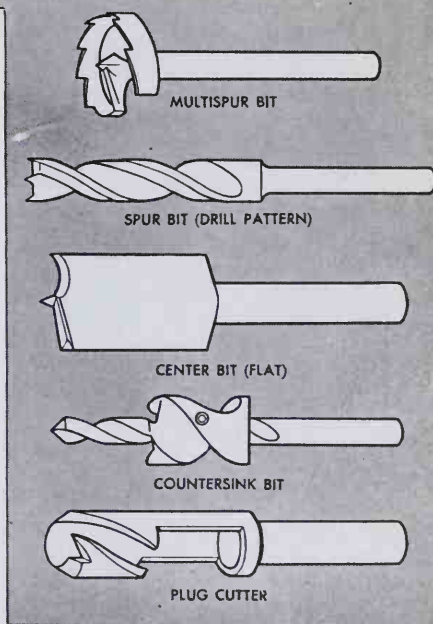


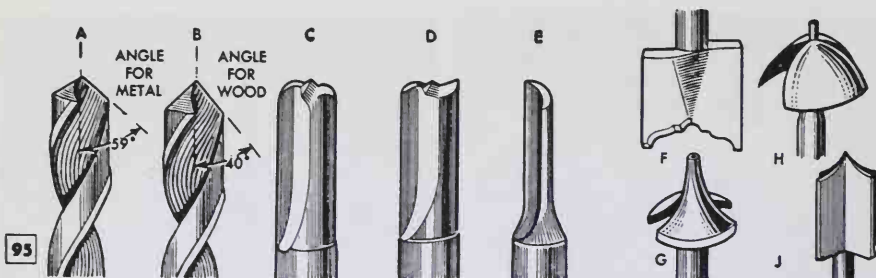


Above and below, the assortment of bits for wood boring, or drilling, covers just about every need of the cabinetmaker. Of course, the ordinary twist drill furnished for drilling metal will also work in wood, but the hole will be a bit ragged because the drill does not sever the wood fibers cleanly and uniformly

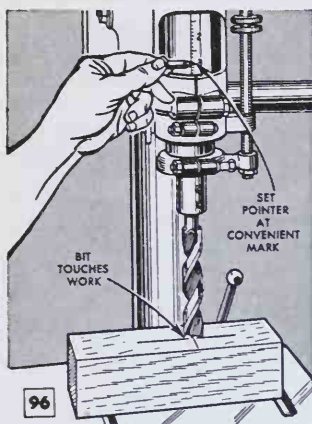


Drilling wood: The first thing to know is how to choose the correct wood-boring bits for the work you want to do. Of course, any twist-drill bit will drill holes in either hard or soft wood, Fig. 95, but the twist drill tends to leave the hole a little rough because it does not sever the wood fibers cleanly. Only a spur bit will produce a clean hole of exact size in wood. Figs 93 and 94 show representative selections. Note the variations, especially the variation in the two types detailed in Fig. 93. The bit detailed at the left is the one you use in a hand brace. It has a screw point to assist in pulling the bit through the wood. The bit detailed at the right has a brad point which serves merely to hold the bit true and at the same time to free the chips at the center of the hole. This type of bit is designed for accurate work in a drill press. It can be driven at high speeds without heating. Now, run your eye down the assortment shown in Fig. 94. With the exception of the plug cutter, which is designed for making short dowels, they all drill holes—but fast! Note that they all have straight shanks for use in





Details A and B show how to grind a twist drill for working in metal, A, and in wood, B. Bits C, D and E are router bits made especially for use in a drill press. F is a rasette cutter and H and J are carving cutters, although they can be used for other work. G is a rounding-over cutter made for rounding corners

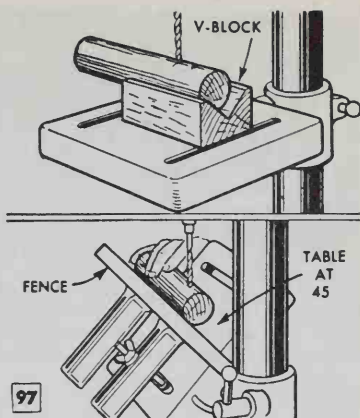
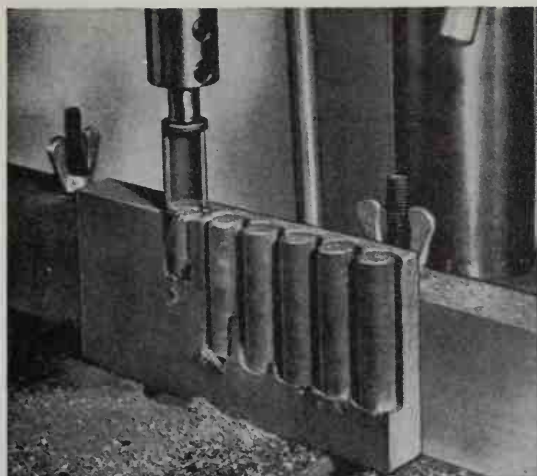


a drill chuck with parallel jaws, and that two of them have screw points. These bits must be driven at slow speeds, otherwise the screw point will tend to "out-run" the cutters and cause the bit to heat unduly. Incidentally, the hollow-spiral bit, single twist, is the same as the ship-auger bit supplied for use in a hand brace, and the expansive bit is a familiar tool to most home craftsmen. As you can see it's also supplied with a straight shank for use in a drill press. However, neither of these bits is widely used.

Router bits, rosette cutters: In Fig. 95 are other types of bits commonly used in the drill press for special jobs. Router bits (the photo at the lower left shows one in use) are obtainable in various sizes with ½-in. shanks. They are for use in the special drill-press spindle pictured on earlier page. They also can be used in the drill chuck for light work. Rosette cutters, rounding-over cutters and carving cutters are for special jobs. Most of these latter cutters are made to order, and although a

few stock sizes are always available, their high cost makes them generally impractical for homeshop use. The left-hand detail in Fig. 95 shows the cutting angles on twist drills for wood and metal. In case you have to use a twist drill in wood, take time to grind it to the 40-deg. angle shown. It will do better work in wood, but must be re-ground to the 59-deg. angle if it is used in metal.

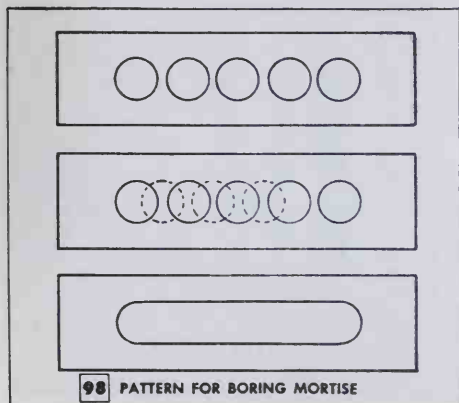
Setting drill press for depth: Some small drill presses are provided with graduated sleeves, or quills, and adjustable pointers, and nearly all types are provided with depth stops. Fig. 96 shows one of the former types and demonstrates how to set the pointer so that you can drill any number of holes to the same depth. Note that the spindle is run down until the bit touches the work, then the pointer is set at any convenient inch mark. By watching the pointer, you can drill to any depth desired within the limits of the spindle travel. This is handy for drilling adjacent holes for mortises, round-end slots, shallow grooves and similar work. On many small drill presses the depth stop has a flat milled on the facing side and this flat surface is graduated in sixteenths of an inch. Knurled spin nuts on



Detail above shows two ways of making a V-block for supporting round stock for accurate drilling. Upper block is of hardwood



Pictured above and detailed below is a simple way of boring to make a round-end mortise. Drilling a series of adjacent holes makes it easy to clean out the waste



98 PATTERN FOR BORING MORTISE

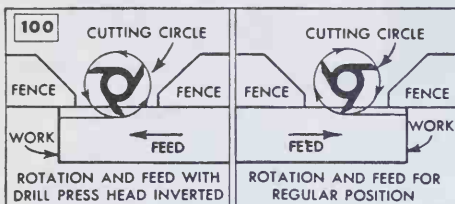
the threaded rod can be set to stop the spindle at any point, thus enabling you to drill any number of holes to a uniform depth. The depth stop is used not only when drilling but also for setting the spindle for routing, mortising with the hollow chisel, making dowels or plugs with a plug cutter and setting shaper cutters to the correct height.

Plug cutting: A plug cutter is simply one type of hollow auger. You'll remember it from Fig. 94, the lower detail. In the photo above you see it in operation. It simply cuts a circular groove around an uncut portion of the wood which is left standing as shown. One of the principal uses of plugs is in plugging counterbored screw holes. If you cut the plugs from the same wood as that of which the project is made you can match the grain so closely that when the surface is sanded smooth the plug is almost invisible. An ordinary dowel is always visible due to the end grain, which will always darken when the finish is applied. Boat builders use these cutters extensively, and every homeshop equipped with a drill press will find use for several sizes.

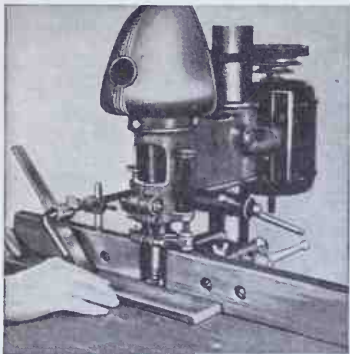
Boring a mortise: You don't have to have a hollow-chisel attachment to make a mortise of the exact size you want. Fig. 98 shows how to make a round-end mortise by using an ordinary brad-point bit or a special router bit. First, determine the length and width of the mortise and mark this on the stock. Then select a bit of the same diameter as the width of the mortise. Bore a hole at each end of the layout, then space holes equally between as in the upper detail. The stock should, of course, be guided against a fence as in the photo above Fig. 98. A small piece of stock clamped to the drill-press table will serve this purpose nicely. After the first row of holes have been drilled



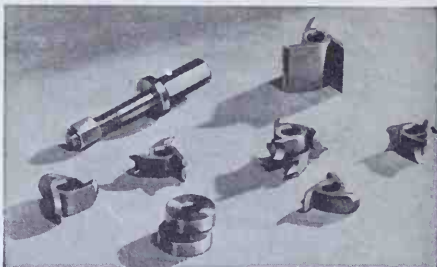
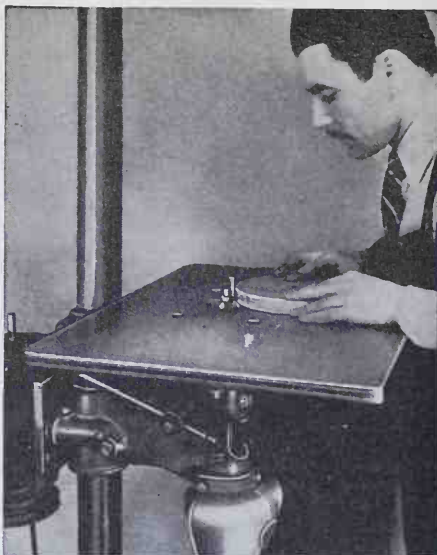
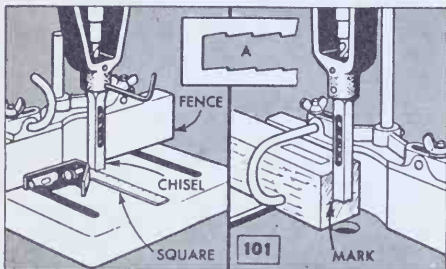
Your drill press can be set up to do a variety of shaper work with the necessary accessories. In the detail above the drill head is being used right-side up for shaping with a guide collar on the spindle. At the right head is inverted below the special table



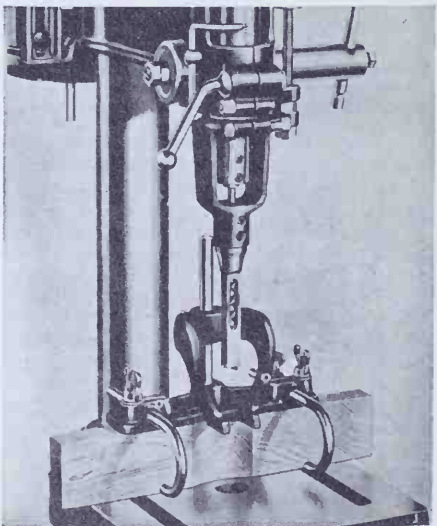
Details above show the correct direction of cutter rotation and feed for the drill-press head above and below the worktable. Below, head is shown in upright position and used with a shaper fence and hold-downs

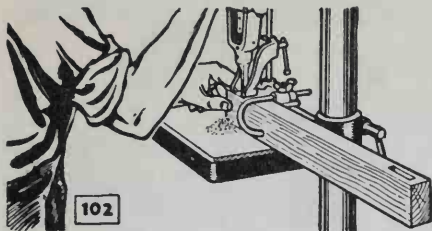


Picture at the right and details below show how the hollow-chisel mortising attachment is set up on a drill press. The drill-press chuck, or spindle, is removed and a special spindle and chisel holder are attached to the quill. The unit makes a square-cornered mortise of uniform width and depth and any length

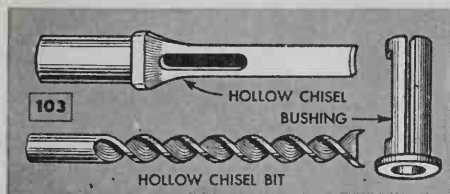


Shaper cutters of the three-lip type, together with a special spindle and rubbing collars, are supplied for shaping on a drill press with, or without, fence

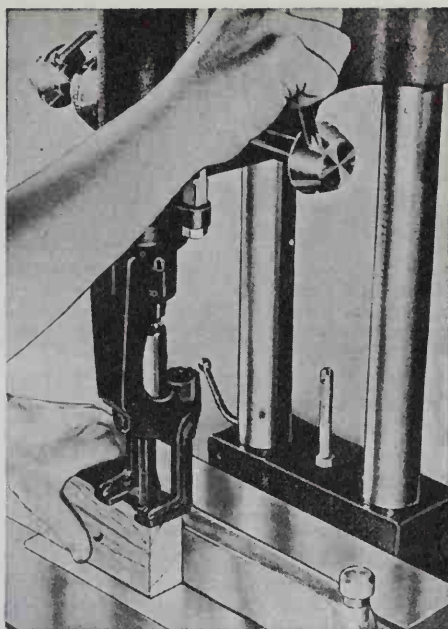




Above, square, hollow chisel cuts down corners of a round hole formed by the bit running inside the chisel. Bit cuts away waste, removes chips without clogging



Chisel unit consists of three parts, the square chisel, the bit, and a bushing as shown above. Right, mortising units vary somewhat for different drill presses



to a uniform depth, drill out the waste as shown by the dotted lines. Then, if you are using a router-type fluted bit insert it in one of the end holes, lower the drill-press spindle to the full depth, and move the stock slowly to the right. The sharp-edged flutes of the router will clean out the remaining waste smoothly, leaving a smooth-walled recess of precise width. If the boring is done with an ordinary brad-point bit, the waste remaining after boring two series of holes is cut out with a wide chisel.

Hollow-chisel mortising attachment: This drill-press accessory makes the mortise complete, with square ends. As supplied for the drill press the accessory consists of

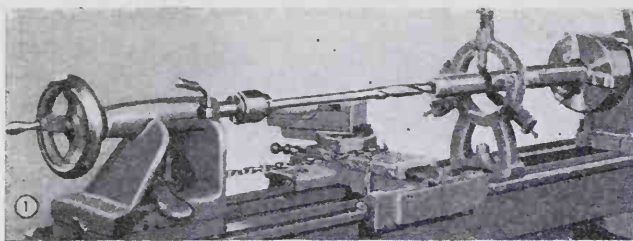
the chisel holder which clamps to the drill-press quill, or sleeve, the guide fence with guide rods, the hold-down and hold-down bracket, the chisel, a special chisel bit and a bushing. These various parts are assembled on the drill press as in the lower right-hand photo on the preceding page and also in the photo and Fig. 102 above. The units vary somewhat as they are made to fit different makes of presses. When you make the setup it is necessary to make sure that the guide fence is located so that the stock will travel exactly at right angles with the back face of the chisel. Otherwise successive strokes of the chisel will result in the "saw-tooth" edges shown in Fig. 101, detail A. The left-hand detail in Fig. 101 shows how to do this with a try square. The right-hand detail shows how to set the chisel for depth. The rest is simplicity itself: place the stock against the fence with the guide lines centered under the chisel and lower the chisel into the wood in a slow uniform stroke to the full depth. Then withdraw the chisel, move the stock a distance equal to the width of the chisel and repeat. The chisel cuts a square hole to a uniform depth at each stroke.

Shaping: A shaping attachment consisting of fence, special spindle, large table and an assortment of shaper cutters is available for most small drill presses. Figs. 99, 100 and the adjacent photos show how to set up and use the attachment. On floor-type drill presses, the head usually is inverted for shaper work.

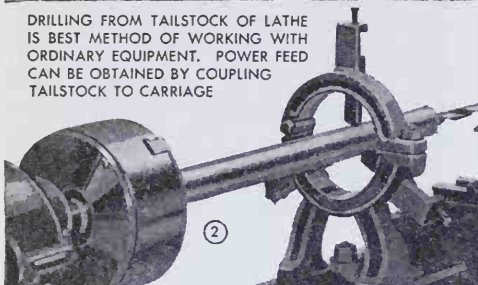
DRILL SIZES FOR WOOD SCREWS

Gauge of Screw	Dia. in Decimals	Body Hole Drill	Lead Hole Drill	Counter-bore Drill
0	.058	53	68	32
1	.071	49	57	20
2	.084	44	56	16
3	.097	40	52	4
4	.111	33	52	B
5	.124	1/8"	52	F
6	.137	28	47	L
7	.150	24	47	O
8	.163	19	42	S
9	.177	15	42	T
10	.190	10	38	X
11	.202	5	38	7/16"
12	.215	7/32"	38	29/64"
14	.242	D	31	33/64"
16	.269	I	28	37/64"
18	.294	19/64"	23	41/64"

DRILLING FROM TAILSTOCK

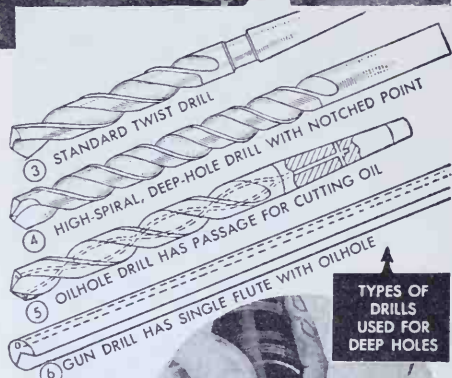


DRILLING FROM TAILSTOCK OF LATHE IS BEST METHOD OF WORKING WITH ORDINARY EQUIPMENT. POWER FEED CAN BE OBTAINED BY COUPLING TAILSTOCK TO CARRIAGE

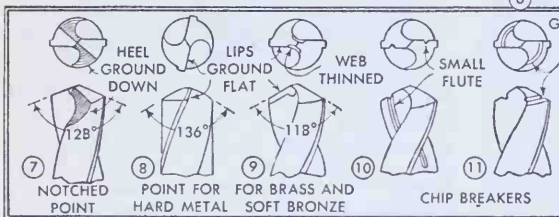


DRILLING cylindrical work from the lathe tailstock, as shown in Fig. 2, is practical for either shallow or deep holes. This method is accurate, easy to set up, and will handle the average job nicely. A power feed, if desired, can be obtained by coupling the tailstock with the carriage by means of a chain, as shown in Fig. 1.

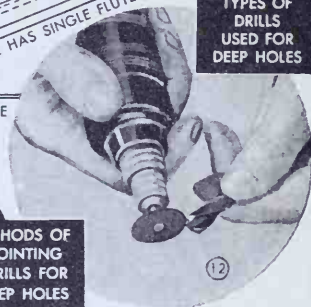
The occasional job of deep-hole drilling can be done with a standard twist drill. For regular work of this kind, the drills shown in Figs. 4, 5 and 6 are preferable. Fig. 4 shows a high-spiral type of twist drill made



TYPES OF DRILLS USED FOR DEEP HOLES



METHODS OF POINTING DRILLS FOR DEEP HOLES



especially for deep-hole work (sometimes called a crankshaft drill). Other than the fast twist, which gives better chip elevation, this drill differs from a standard twist drill in that it has a notched point. Fig. 5 shows a standard twist drill with oilholes through the solid metal. It requires a special socket which permits coupling to a force-feed oil line. The cutting oil cools and lubricates the drill, and washes the

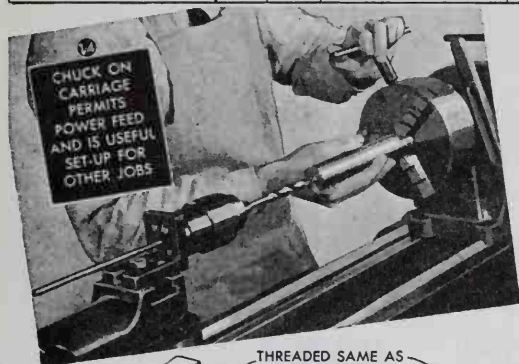
chips out through the flutes. The gun drill, Fig. 6, also works on the force-feed system, chips being washed out through the single flute. Properly supported, it is the truest tracking of all deep-hole drills.

You can drill to almost any depth with a standard type of twist drill by simply backtracking the drill frequently. The hole should be drilled about one diameter or less, then the drill should be withdrawn

19 DEEP-HOLE DRILLING PRACTICE WITH STANDARD TWIST DRILLS

Material	F.P.M.*	Feed	Cutting Comp.	Style of Drill Point
Aluminum	250	Depends on drill size: Under $\frac{1}{8}$ "—.001 to .002 in. per revolution $\frac{1}{8}$ " to $\frac{1}{4}$ "—.002 to .004 $\frac{1}{4}$ " to $\frac{1}{2}$ "—.004 to .008 $\frac{1}{2}$ " to 1"—.008 to .015 Over 1"—.015 to .025	50-50 Kerosene and Lard Oil	Sharp point—90° to 110° included angle
Brass and Soft Bronze	200		Dry or Soluble Oil	Standard 118° point with cutting lips flattened
Soft Cast Iron	120		Dry	90° to 118° included angle
Soft Steel	110		Soluble Oil, Mineral Lard Oil or Sulphurized Oil	Notched point, 118°
Tool Steel	60			125° to 135° included angle—angle increases with hardness
Cast Plastic	250		Dry (withdraw drill frequently)	118°—Relieve heel as shown in Fig. 7 but without notching web

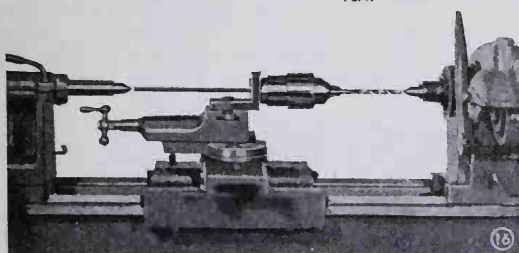
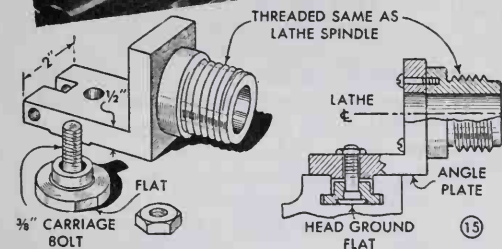
* For high-speed steel drills



angle is 128 degrees, which is a bit sharper than the normal 118 degrees. The web is thinned by grinding away the heel, as shown. This drill penetrates easily, the notched point eliminating the noncutting web of the standard twist drill. If the work is very hard, a blunt point, as in Fig. 8, with the cutting lips slightly flattened, will cut and hold up better. The same treatment of flattening the lips is required when drilling brass, Fig. 9, but in this case the included angle is the standard 118 degrees. Fig. 9 also shows web-thinning by grinding with a round edge wheel. A moderate amount of this is good practice, especially on larger drills.

Figs. 10 and 11 show two styles of chip breakers. The purpose of a chip breaker is to divide and break up the chip so that it can be expelled readily through the flutes of the drill. In factory-made drills of this style, the chip breaker consists of one or more flutes within the main flute, as in Fig. 10. A simpler style for occasional work is shown in Fig. 11, where the chip-breaking flute is ground on the end of the drill. Fig. 12 shows how the work is done with a hand grinder fitted with a cutoff wheel.

A summary of drilling practice with standard twist drills is given in Fig. 13. Power feed is sometimes



completely. This method of drilling clears the hole of chips, allows the drill to cool, and gradually wears away any hard spots on the walls of the hole. If the drill is not long enough, a shank of suitable length and diameter can be welded on. One important thing to check is the margins of the drill. A high, clean margin is absolutely necessary—don't try deep-hole drilling with a drill that has margins worn away, especially within 1 in. of the lips.

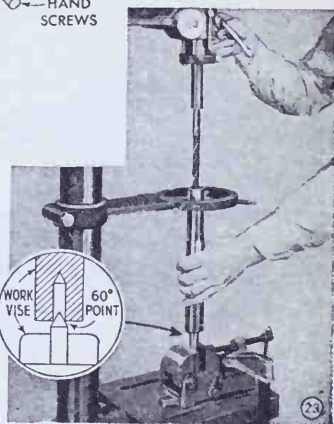
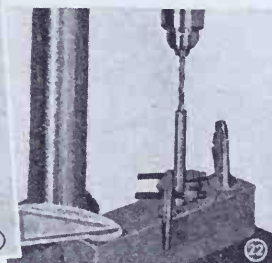
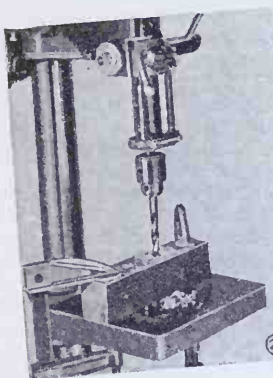
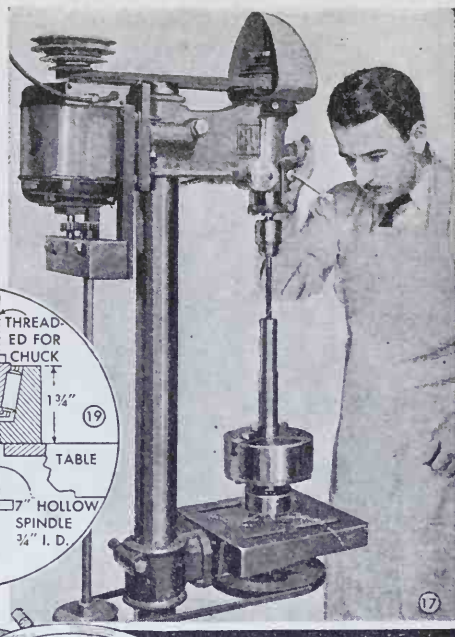
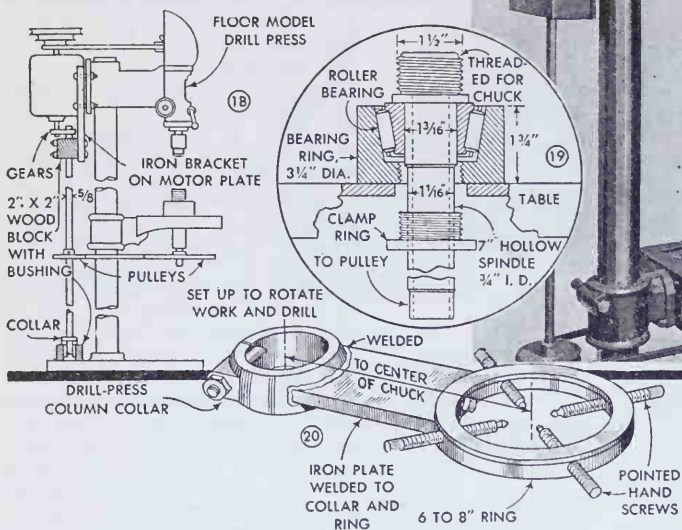
Special pointing of the drill is sometimes helpful. Fig. 7 shows the best all-around point for deep-hole drilling. The included

a desirable feature because it keeps the chip uniform and unbroken. Besides the chain method shown in Fig. 1, power feed on the lathe can be obtained by drilling from the carriage, as shown in Figs. 14 and 15. This setup is easily aligned by using a straight rod or the drill itself, as in Fig. 16.

When the work is done on the drill press, various methods can be used to assure an accurate hole. Many machinists rotate both work and drill, as shown in Figs. 17, 18 and 19. The diagram, Fig. 18, shows a 1:1 ratio from motor to pulley spindle, but a reduction of 2:1 is better as it decreases vibration

and gear noise. A further reduction is obtained by the pulleys, so that the final speed of about 200 r.p.m. is obtained.

Figs. 21 and 22 picture one of the best methods of drilling round work of small diameter. A wood block is clamped to the drill table and a drill of the same diameter as the work is used to run a hole into the block, as in Fig. 21. Then the work is mounted in the hole, with the actual work drill in the drill chuck as in Fig. 22. Note

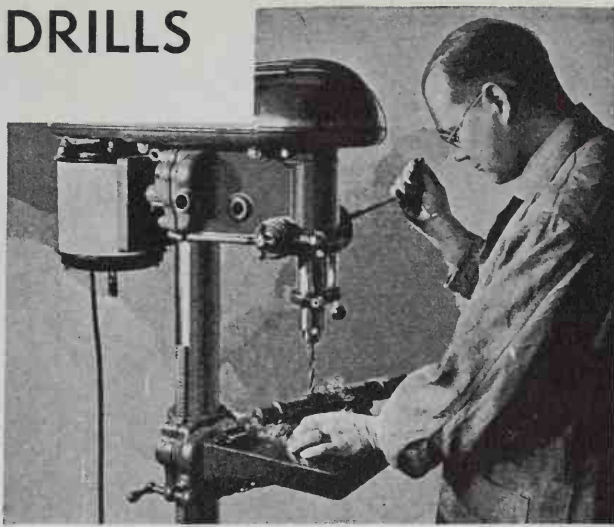


that the drill table and the wooden block remain in a fixed position.

In drilling long work on a drill press, the biggest difficulty is holding the work upright. For this purpose, the ring shown in

Fig. 23 is excellent. The bottom end of the work is supported on a 60-degree point held in a drill vise, the point being aligned exactly below the drill point previous to the drilling operation.

DRILLS



Practical data for every shop man on the technique of using drills; how to select the right type for certain jobs, what speeds for efficiency and many other pointers

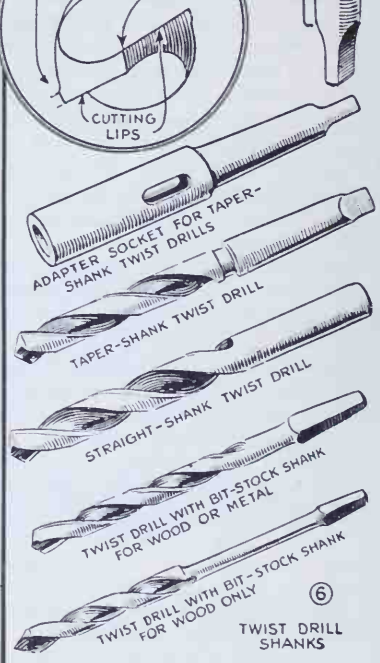
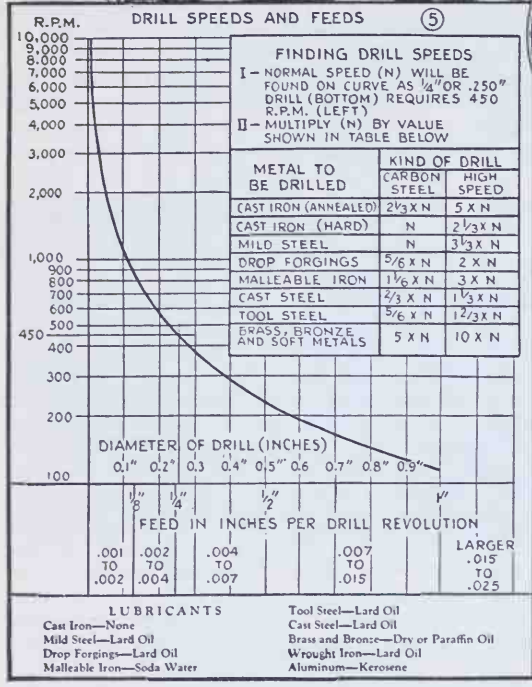
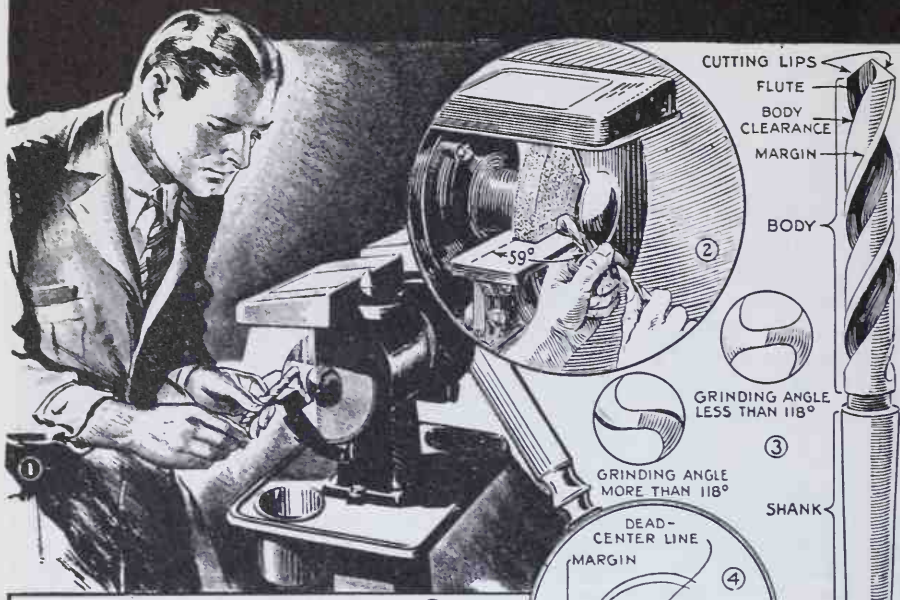
CLOSE examination of a drill of any size will reveal that there are three main operating parts which enable this tool to do its important job. As you will see from Fig. 3, these are the shank, the fluted body, and the cutting lips. Like all cutting tools which remove material in the form of chips, the lips of the drill must be ground with a clearance and rake angle. Each lip is really a chisel, each must have exactly the same clearance and rake, and, due to the characteristics of the drill and the nature of the materials in which it must work, the uniformity of these angles determines its performance.

Types of Twist-Drill Shanks: Fig. 6 shows the four standard shanks which are in general use. The taper-shank drill is used in a drill press, the hollow spindle of which has an internal taper. When the shank does not fit the drill-press socket, a suitable adapter is used. The straight shank is the type most commonly used. It fits both drill-press and hand-drill chucks. Bit-stock shanks may be used in ordinary bit braces. The type of drill used for wood only has a sharper point angle, it is possible to easily distinguish wood-working drills from those made for metal.

Body and Flutes: The body of the drill, Fig. 3, consists of a spirally fluted section to give strength, curl the chips, provide a

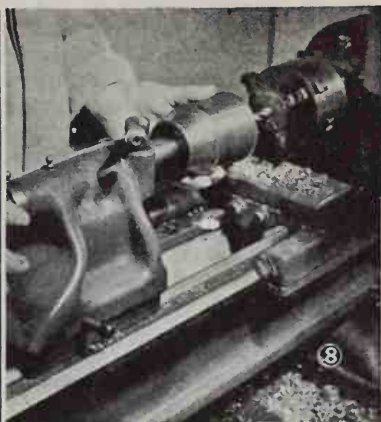
means whereby they may be ejected, and to allow for the entrance of oil or cutting compounds to lubricate and cool the drill. Note that the outside edges of the flutes are ridged to form a margin of slightly greater over-all diameter than the rest of the body. The recessing back of the margin is very slightly tapered toward the shank to give the drill body clearance and prevent binding. The angle between the flutes and work when the drill stands perpendicularly, Fig. 10, is the rake angle. The steeper this angle, the tighter the chips are rolled. For most jobs the angle produced when the drill is manufactured is satisfactory.

Cutting Lips and Grinding Methods: From the standpoint of shop care, the most important parts of the drill are the point and cutting lips. Fig. 4 shows an enlarged point-on view from which it should be observed that the faces on either side of the dead-center line are ground to a very definite angle and when this is done, the edges of the cutting lips are parallel as shown. If a gauge, Fig. 11, is placed across the tip of a properly ground drill with its edges parallel to the cutting lips, it will be found that the angle is 118° . As it is possible to grind a drill more on one side than on the other and still produce this angle, the marks on the gauge should also be observed. With the point registering with



Causes and Cures for Drill Troubles ⑦

TROUBLE	CAUSES	CURES
 A—Broken Drill	1—Work mounted so that it is springy 2—Not enough lip clearance 3—Dull drill 4—Speed low or feed too fast 5—If drilling wood, brass or soft metal, chips may pack in flutes	1—Fasten work rigidly so it cannot spring 2—Regrind properly 3—Grind 4—Increase speed or feed slower 5—Increase speed, grind drill with more lip clearance or use drills designed for the material
 B—Breaking of Cutting Edges—Particularly at Corners	1—Too much lip clearance 2—Material has hard spots, sand inclusions or scale 3—Drill running too fast 4—Wrong cutting compound or lubricant 5—Feed too rapid	1—Regrind and reduce lip clearance to between 12 and 15 degrees 2—Reduce speed 3—Reduce speed 4—Use proper lubricant or compound 5—Reduce feed
 C—(High-Speed Drill) Chipping or Checking	1—Drill heated or cooled too rapidly while drilling or grinding 2—Feeding too rapidly	1—Warm drill slowly before using—Do not use cold water while drilling or grinding 2—Reduce feed
 D—Oversize Hole	1—Lip angles are not equal	1—Regrind drill and equalize lip angles
 E—Oversize Hole	2—Length and angle of lips not equal	2—Regrind drill and equalize lip angles and lip lengths
 F—Oversize Hole	3—Length of lips not equal (Lip angles o.k.)	3—Regrind and equalize lip lengths
 G—Oversize Hole	4—Spindle of drill press loose	4—Tighten or adjust until spindle is rigid
 H—Broken Tang	1—Poor fit of tang in socket caused by nicks, burrs, dirt or wear 2—Mutilated tang	1—Ream out socket or replace with new one. Cleaning sockets before use lengthens their life 2—Dress or replace
 I—Hole Is Rough	1—Drill dull 2—Drill not properly ground 3—No lubricant or wrong lubricant 4—Feed too rapid 5—Work poorly supported	1—Grind 2—Inspect and regrind 3—Use proper lubricant 4—Reduce feed 5—Support work rigidly and free from vibration
 J—Form of Chips Tells How Work Is Progressing	1—Chip changes form 2—Lubricant not reaching proper location	1—Drill chipped, dulled or damaged—Inspect and regrind 2—Remove drill and check lubricant



the center "O" line, the readings at the points where the edges of the lips meet the gauge should be the same to insure that the cutting lips are at the same angle with respect to the center line of the drill. In the case shown, this value reads one in both cases, therefore, the drill has not only been ground to the proper total angle but it is also ground with equal cutting-lip angles. A drill which is ground so that one of the cutting lips is longer than the other will not drill accurately. Fig. 7 shows the troubles which result from improper cutting-lip angles. Other illustrations in Fig. 7 show the cause and cure for other drill difficulties.

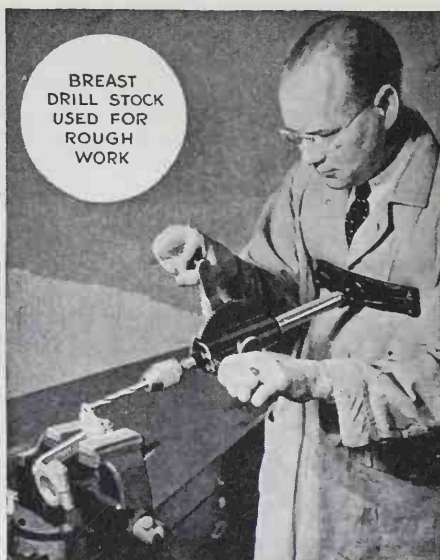
Clearance Angle: If the gauge, Fig. 11, is rotated until its edges meet the two points of the faces back of the cutting lips, it will be found that the gauge no longer rests on the flat surfaces. Fig. 12 shows this condition clearly. The angle at this point is therefore less than 118°. The difference between 118° and this angle is the clearance angle. If a drill has no clearance, that is, the angle across the points shown in Fig. 12 is 118°, the flat areas will ride on the work without cutting. To get a better idea of the necessity for lip clearance in all cutting tools, look at Fig. 9 and the left detail in

Fig. 10. The angle between a line drawn squarely across the point with a line drawn between the cutting-edge tip and the heel or trailing edge of the lip should span an angle between 12 and 15° for best results.

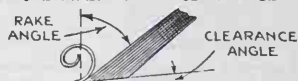
For a practical method of determining when the lips of a drill have been ground to a proper angle compare the two point-on views in Fig. 3 with that in Fig. 4. Note the variations in the curve of the cutting edges caused by varying the angle. On the other hand, when the drill is properly ground as in Figs. 1 and 2, with the correct clearance angle, the cutting edges will be parallel as in Fig. 4. In other words, the cutting edges are in the form of a straight line offset by the dead-center line and the trailing edges back of them are rounding.

When drilling very hard material, it has been found helpful to modify the rake angle slightly, as shown in Fig. 17. The nearer this angle is made to 90° the tighter the chips will be rolled and the less will be the likelihood of breaking or chipping the cutting lip. This modification should not be made except in those cases where very hard material is being drilled and when the use of proper lubricants, as explained later, has failed to produce satisfactory results without damage to the drill.

Grinding High-Speed Drills: When grinding carbon-steel drills they are cooled by immersion in water to avoid burning. This practice must not be used with high-speed drills as sudden changes of temperature check, crack, and weaken them. They will stand high temperatures if heated slowly. Accordingly, they should be ground slowly to avoid sudden overheating and must be allowed to cool in the air to prevent checking. For grinding drills, a good grade of vitrified Alundum wheel should be selected, the most acceptable type being grade K, grain M. The grinder should be operated at a surface speed of between 4,000 and 5,000 feet per minute. A good rule for finding the speed in r.p.m. required is to divide the diameter of the wheel in inches into 14,000. Thus, a 10-in. wheel should run at 1,400 r.p.m. The drill is carefully brought up to the edge of the grinder as shown in Figs. 1 and 2, and should be held rigidly, the angle between the wheel and the drill being maintained at 59°. After a little practice, this is a simple operation and the eye will be adequate to insure an accurate job. As the drill is brought up to the wheel, it should be rotated clockwise while at the same time the angle is gradually decreased to produce the clearance.



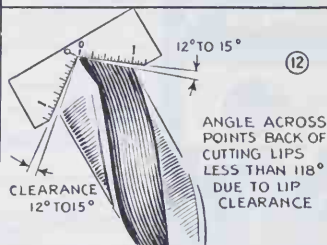
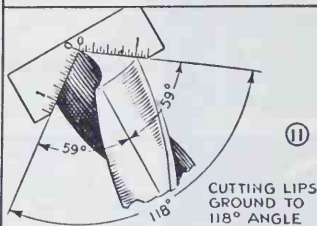
ALL CUTTING TOOLS MUST BE OPERATED WITH CLEARANCE



CLEARANCE ANGLE PERMITS CHISEL TO CUT ⑨



⑩ WITH A LARGE RAKE ANGLE THE CHIPS ARE CURLED TIGHTLY





Sizes, Feed and Speeds: The ordinary jewelers' drills, or, as they are sometimes called, steel wire-gauge drills, are numbered from 1 to 80, the No. 1 drill being the largest and No. 80 being the smallest. Letter-sized drills bear the alphabetical letters from A to Z, the A drill being the smallest and the Z drill the largest of the series. In addition to wire-gauge drills and letter drills, jobbers drills are made in sizes ranging upward in steps of $\frac{1}{64}$ in., from $\frac{1}{32}$ in. to several inches in diameter. To make it convenient to select the proper size of drill for any purpose, refer to Fig. 13 which includes the various size drills of each type listed in the order of increasing sizes. Although power-driven drill presses constitute the most satisfactory means of using drills, various drill stocks, both manually and electrically driven, Fig. 15, are in common use. Many exacting drilling operations are also handled in the lathe as in Fig. 8. For small drills, light-weight high-speed geared hand-drill stocks should be selected. The larger sizes of hand-drill stocks are made so that the driving wheel can be set for either one of two speed ratios, the low ratio being used for larger drills. The handle also can be adjusted to increase the leverage. Ordinary drill presses are usually equipped with $\frac{1}{4}$ -hp. motors. These are satisfactory for drilling holes up to $\frac{3}{8}$ in. in diameter. For heavier work, larger motors should be

FIG. 13
Steel Wire and Jobbers Drills in Sizes Up to $\frac{1}{4}$ "

Wire Gauge Drills	Jobbers Drills	Decimal Size	Wire Gauge Drills	Jobbers Drills	Decimal Size
No. 80		.0135	No. 37		.1040
No. 79		.0145	No. 36		.1065
No. 78		.0160		$\frac{7}{64}$ "	.10938
No. 77		.0180	No. 35		.1100
No. 76		.0200	No. 34		.1110
No. 75		.0210	No. 33		.1130
No. 74		.0225	No. 32		.1160
No. 73		.0240	No. 31		.1200
No. 72		.0250		$\frac{1}{8}$ "	.12500
No. 71		.0260	No. 30		.1285
No. 70		.0280	No. 29		.1360
No. 69		.02925	No. 28		.1405
No. 68		.0310		$\frac{9}{64}$ "	.14063
	$\frac{1}{32}$ "	.03125	No. 27		.1440
No. 67		.0320	No. 26		.1470
No. 66		.0330	No. 25		.1495
No. 65		.0350	No. 24		.1520
No. 64		.0360	No. 23		.1540
No. 63		.0370		$\frac{5}{32}$ "	.15625
No. 62		.0380	No. 22		.1570
No. 61		.0390	No. 21		.1590
No. 60		.0400	No. 20		.1610
No. 59		.0410	No. 19		.1660
No. 58		.0420	No. 18		.1695
No. 57		.0430		$\frac{11}{64}$ "	.17188
No. 56		.0465	No. 17		.1730
	$\frac{3}{64}$ "	.04688	No. 16		.1770
No. 55		.0520	No. 15		.1800
No. 54		.0550	No. 14		.1820
No. 53		.0595	No. 13		.1850
	$\frac{1}{16}$ "	.06250		$\frac{3}{16}$ "	.18750
No. 52		.0635	No. 12		.1890
No. 51		.0670	No. 11		.1910
No. 50		.0700	No. 10		.1935
No. 49		.0730	No. 9		.1960
No. 48		.0760	No. 8		.1990
	$\frac{5}{64}$ "	.07813	No. 7		.2010
No. 47		.0785		$\frac{13}{64}$ "	.20313
No. 46		.0810	No. 6		.2040
No. 45		.0820	No. 5		.2055
No. 44		.0860	No. 4		.2090
No. 43		.0890	No. 3		.2130
No. 42		.0935		$\frac{7}{32}$ "	.21875
	$\frac{3}{32}$ "	.09375	No. 2		.2210
No. 41		.0960	No. 1		.2280
No. 40		.0980		$\frac{15}{64}$ "	.23438
No. 39		.0995		$\frac{1}{4}$ "	.25000
No. 38		.1015			

Letter Drills	Jobbers Drills	Decimal Size	Jobbers Drills	Decimal Size
A	$\frac{15}{64}$ "	.2344	$\frac{33}{64}$ "	.5156
B		.238	$\frac{17}{32}$ "	.5313
C		.242	$\frac{35}{64}$ "	.5469
D		.246	$\frac{9}{16}$ "	.5625
E	$\frac{1}{4}$ "	.2500	$\frac{37}{64}$ "	.5781
F		.257	$\frac{19}{32}$ "	.5938
G		.261	$\frac{39}{64}$ "	.6094
H	$\frac{17}{64}$ "	.2656	$\frac{5}{8}$ "	.6250
I		.272	$\frac{41}{64}$ "	.6406
J		.277	$\frac{21}{32}$ "	.6563
K	$\frac{9}{32}$ "	.2812	$\frac{43}{64}$ "	.6719
L		.290	$\frac{11}{16}$ "	.6875
M	$\frac{19}{64}$ "	.2989	$\frac{45}{64}$ "	.7031
N		.302	$\frac{23}{32}$ "	.7188
O	$\frac{5}{16}$ "	.3125	$\frac{47}{64}$ "	.7344
P	$\frac{21}{64}$ "	.3281	$\frac{3}{4}$ "	.7500
Q		.332	$\frac{49}{64}$ "	.7656
R	$\frac{11}{32}$ "	.3437	$\frac{25}{32}$ "	.7813
S		.348	$\frac{51}{64}$ "	.7969
T	$\frac{23}{64}$ "	.3594	$\frac{13}{16}$ "	.8125
U		.368	$\frac{53}{64}$ "	.8281
V	$\frac{3}{8}$ "	.3750	$\frac{27}{32}$ "	.8438
W	$\frac{25}{64}$ "	.3906	$\frac{55}{64}$ "	.8594
X		.397	$\frac{7}{8}$ "	.8750
Y	$\frac{13}{32}$ "	.4063	$\frac{57}{64}$ "	.8906
Z		.413	$\frac{29}{32}$ "	.9063
	$\frac{27}{64}$ "	.4219	$\frac{59}{64}$ "	.9219
	$\frac{7}{16}$ "	.4375	$\frac{15}{16}$ "	.9375
	$\frac{29}{64}$ "	.4531	$\frac{61}{64}$ "	.9531
	$\frac{15}{32}$ "	.4688	$\frac{31}{32}$ "	.9688
	$\frac{31}{64}$ "	.4844	$\frac{63}{64}$ "	.9844
	$\frac{1}{2}$ "	.5000	1"	1.0000

used, as indicated in Fig. 18. Small drills must be operated at much higher speeds than larger ones. To calculate the proper speed with the various metals and in connection with both carbon steel and high-speed drills, make use of Fig. 5. This chart will be found a great shop convenience as it condenses several pages of hard-to-read figures into easily used form.

Laying Out Work for Drilling: In laying out drilling jobs, a combination square may be used for measuring angles, for locating centers, etc. A scribe and other tools are indispensable to accurate work. Having located the exact point to be drilled, it next remains to impress into it a center punch mark of sufficient depth to insure that the point of the drill will be guided properly as in Fig. 14.

Drifting a Wandering Drill: Sometimes a drill will show a stubborn tendency to wander off the punch mark when starting the hole. To correct this you first check up on the condition of the drill and see that the work is level. After eliminating these possibilities, remember that the relation between the circle described by the dead-center line of the drill and the diameter of the punch impression has a definite bearing on accurate starting of the drill. If the first circle is larger than the second the punch mark will have no wedging or "drawing" effect on the drill, thus failing to hold it on center until the lips begin to cut. The remedy is to use either a punch with a shorter bevel, Fig. 14, or spot the hole with a smaller drill before introducing the larger size. Where the work requires extreme accuracy, holes are frequently spotted with several progressive drill sizes. Another method used where dimensions are not critical is that in Fig. 16. Here the drill, starting off-center as at A, is drifted back by means of cold-chisel impressions as at B and C.

Drill Blocks: Blocks and flat sections of steel are useful around the drill press. When sections of cold-rolled steel plates about $\frac{1}{4}$ in. thick are used as pads under the work, the drill may be allowed to go through without damaging the drill-press table. Materials which tend to form a burr on the bottom are drilled clean if a plate is used under the work.

In drilling fiber, soft metal, plastics, and other materials which tend to form a burr



DRIFTING DRILL CENTER WHICH FAILS TO FOLLOW CENTER-PUNCH MARK

COLD-CHISEL IMPRESSIONS

PROPER LOCATION
ACTUAL LOCATION
A-HOLE STARTS TO ONE SIDE
B-MARKED WITH CHISEL
C-DRILL SHOULD THEN DRIFT TO PROPER LOCATION

RAKE ANGLE CHANGED FOR HARD METAL BY GRINDING

FACES GROUND SLIGHTLY TO INCREASE RAKE ANGLE

POWER REQUIRED FOR DRILL PRESSES

LARGEST DRILL SIZE	HORSEPOWER OF MOTOR REQUIRED
$\frac{3}{16}$ IN.	$\frac{1}{4}$
$\frac{1}{8}$ IN.	$\frac{1}{4}$ TO $\frac{1}{2}$
$\frac{1}{2}$ IN.	$\frac{1}{2}$ TO $\frac{3}{4}$
$\frac{3}{8}$ IN.	$\frac{1}{2}$ TO 1
$\frac{7}{8}$ IN.	1
$1\frac{1}{8}$ IN.	1 TO $1\frac{1}{2}$

(17) (18)

or jagged edge as the drill cuts, it is advisable to clamp a thin piece of metal on top of the work as well as place a drill pad under it. If the work, together with the top plate and drill pad, is clamped to the bed of the press, it is possible to drill through the assembly without forming burrs on either top or bottom. Where it is not possible to drill through a top plate, a hole of the required diameter is drilled in a piece of flat metal and this is placed over the center-punched fiber. With the drill lined up with the punch mark, through the hole in the top plate, the clamps are tightened and the job completed.

The Mechanics of DRILLS

WEB THICKNESS INCREASES TOWARD SHANK OF DRILL

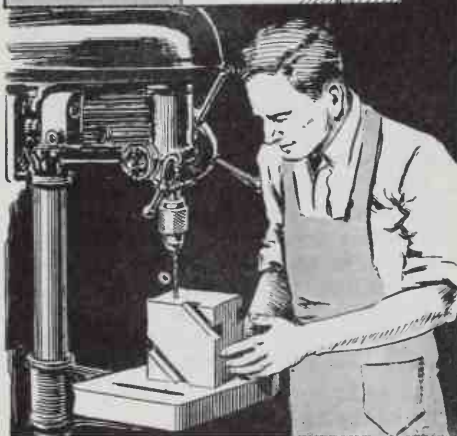
WEB THINNED BY GRINDING ON SQUARE-FACED WHEEL

(19)

Useful information for the shop on setting up work, avoiding drill breakage, drilling hard rubber and plastics and a table of tap and body-drill sizes

A MAJORITY of drilling operations are carried out with drills which have been ground a number of times. As the web, or central section tapers, repeated grinding causes it to grow thicker as in Fig. 19. There comes a time when the web section at the point is so thick that the drill will no longer operate properly, Fig. 20. To correct this condition the regular grinding procedure should be followed by thinning the web as in Fig. 19. The drill is applied to the wheel as shown, first on one side and then the other. The resultant thinning brings the web back to normal thickness.

Drilling Large Holes: Large drills have thick webs and therefore require considerable power. For many purposes it is more practical to drill a lead or pilot hole as shown in Fig. 21. The pilot hole should be of the same diameter as the thickness of the web. The hole should not be made larger than the thickness

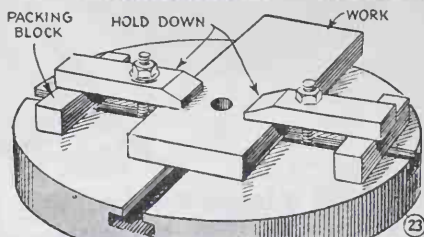
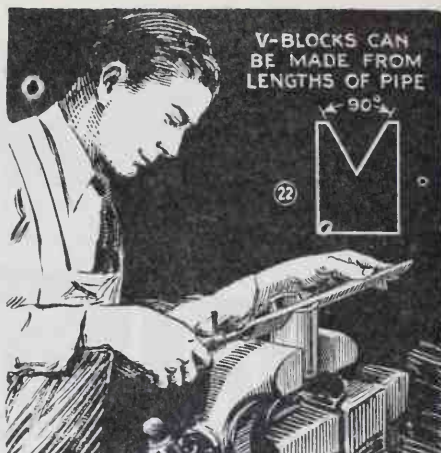


of the web as this would result in chattering and possible drifting.

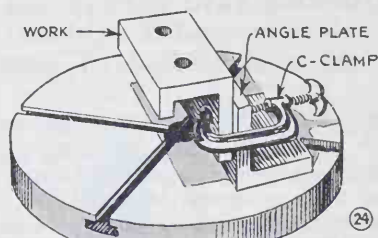
Drilling Deep Holes: If the depth of a hole exceeds the flute length of the drill, Fig. 28, there will be no means for the escape of chips. In this case, it is, of course, advisable to use a longer drill. If this is impossible, then the next best thing is to lift the drill every few seconds and clear the flutes and the hole of chips, continuing this precaution until the hole has been finished to the required depth.

Drilling Out Threads: The enlarging of threaded holes presents a problem which can be overcome most readily by the use of left-handed drills. If an ordinary right-handed drill is used to enlarge a hole which has right-hand threads, it will be drawn into the hole more rapidly than it should, jam, and probably break the drill. Left-hand drills must be revolved in the reverse direction by crossing the belt between the motor and the drill press.

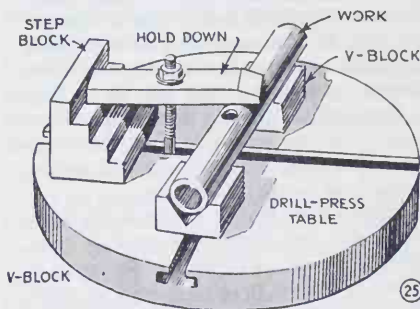
Fixtures and Accessories for Drilling: Although drills will perform fairly well even when improperly used, they can be made to do many apparently impossible jobs if a little time is spent in preparing a number of simple accessories and fixtures. The most useful items are "V" blocks. These can be purchased at little cost or can be made as needed. A form of V block is easily made from a length of pipe as in Fig. 22. The pipe is marked with a scriber and the vee cut out with a hacksaw. The base and "veed" surfaces are then filed smooth and true. Fig. 23 illustrates a simple method of securing a piece of stock to the table of the drill press. The hold-down clamps are simply flat pieces of steel with the outer ends supported on packing blocks, holes being drilled through the centers to facilitate bolting down. Fig. 27 shows a common error in supporting work while drilling. Here the drill has been started at a considerable distance from the supporting blocks. Under pressure of drilling the work will spring. The result is almost invariably a broken drill bit. When drilling small holes in solid stock that rests squarely on the drill table, the work can be held safely in the hand but when drilling larger holes in irregular-shaped stock the practice is dangerous, as the drill may "bite" unexpectedly and jerk the piece out of the hands. Better to set



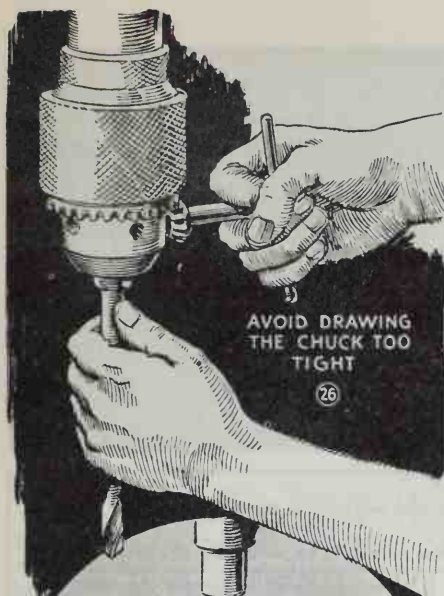
CLAMPING FLAT STOCK FOR DRILLING



IRREGULAR WORK CLAMPED TO ANGLE PLATE

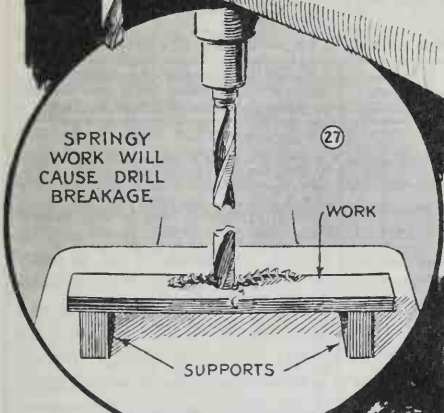


ROUND WORK SET UP FOR DRILLING



AVOID DRAWING
THE CHUCK TOO
TIGHT

26

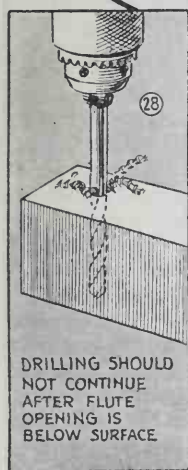


SPRINGY
WORK WILL
CAUSE DRILL
BREAKAGE

27

WORK

SUPPORTS



DRILLING SHOULD
NOT CONTINUE
AFTER FLUTE
OPENING IS
BELOW SURFACE

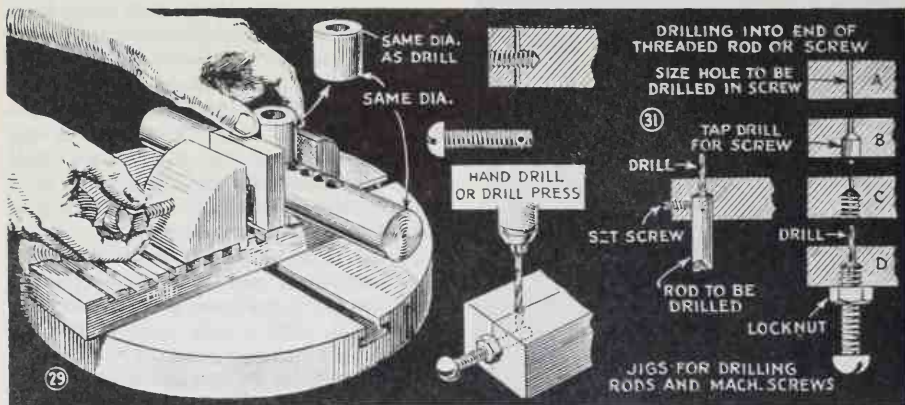


up the job as in Figs. 24 and 25 using an angle plate or a step block, both these supporting members being bolted or clamped to the drill table. Another frequent source of trouble and sometimes breakage, is the tendency to undue tightening of a precision drill chuck, Fig. 26. Drawing the chuck unduly tight, particularly on a small drill, will eventually cause the chuck jaws to be inaccurate. Release of the drill is also difficult. Another accessory which is easily made up as needed, is the drill stop, Fig. 33. This is particularly useful when a number of holes must be drilled to the same depth with a drill press which has no scale or adjustable stop.

Drilling Holes in Round Stock: Difficulties in drilling holes through round bars and rods may be overcome easily if the method shown in Fig. 29 is used. A short length of round stock of the size which is to be drilled transversely is drilled longitudinally as in Fig. 29. This section of drilled stock may then be used as a collet to guide the drill. For this purpose it is essential that a drill-press vise be used. A drill block of width slightly less than the diameter of the round stock is placed in the bottom of the vise and on top of this the shaft to be drilled. Next, the collet is set on top of this section at the exact location where the hole is to be drilled.

Making Slots in Shafts: Another problem is that of making slots in shafting. This job is easy if a drill collet of the type just described is set up in the drill-press vise just as shown in Fig. 26. After drilling the first hole, the collet is shifted to the next position and the second, third and other holes as required are drilled. Following the drilling of the required number of holes the excess metal is removed.

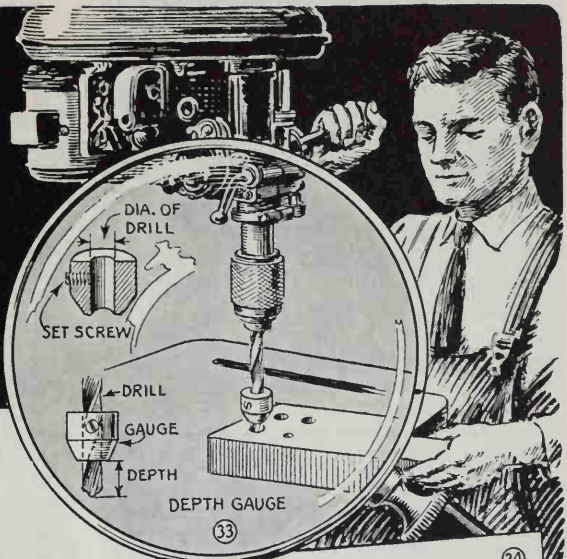
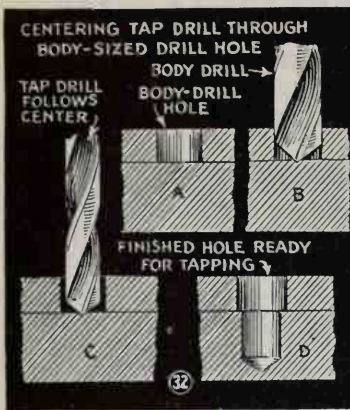
Drilling Small Parts: Small parts such as machine screws, rods, etc., present drilling problems which can be handled easily by the application of a few tricks. For example, a small machine screw which must have a tiny hole drilled through it as shown at the left in Fig. 31. The only item needed for this job is a bar of steel dressed true and square. First, lay out scriber marks and center punch for drilling a hole of exactly the size which is to be drilled through the screw. Next, you consult the table of tap-drill sizes, Fig. 30,



and drill another hole at right angles which can be tapped to a depth sufficient to allow the screw to be inserted far enough to properly locate the transverse hole. Having tapped the hole, the screw is run in over a nut which can be used to lock it in place. Then you drill through the screw, the first hole acting as a guide. This fixture can be used repeatedly. Details at the right in Fig. 31 show another easy method of solving a common problem. In this case it is required to drill a hole into the end of a machine screw or tapped rod. When it is necessary to drill the hole into the end of an unthreaded rod a set screw is provided in the working plate. Holes which are to be threaded should be drilled undersized so that the tap will cut a thread deep enough to hold securely. Although the table presented in Fig. 30 is rather more complete than usual, it is handy to have a rule which can be applied for finding tap-drill sizes for odd screws. The simplest method of doing this is to first divide the number of threads per inch on the screw into .9 and subtract the quotient from the body size of the screw. To illustrate the method, suppose you have a $\frac{3}{8}$ -in. screw which

FIG. 30—TAP AND BODY DRILL SIZES FOR MACHINE SCREWS INCLUDING NUMBER SIZES, A.S.M.E., U.S.S. AND S.A.E. STANDARD SCREWS

Body Drill Size	Screw Number or Size	Threads per Inch and (Tap Drill Size) (Number in parenthesis is tap drill size for preceding number of threads per inch)
No. 52	0	80 (.58)
No. 49	1	56 (.54), 64 (.53), 72 (.53)
No. 44	2	48 (.52), 56 (.51), 64 (.50)
No. 39	3	40 (.49), 48 (.48), 56 (.45)
No. 33	4	32 (.45), 36 (.45), 40 (.44), 48 (.42)
No. 30 or $\frac{1}{16}$ "	5	30 (.42), 32 (.42), 36 (.40), 40 (.39), 44 (.37)
No. 28	6	30 (.36), 32 (.36), 36 (.34), 40 (.33)
No. 21	7	28 (.32), 30 (.31), 32 (.31), 36 (.31 or $\frac{1}{16}$ ")
No. 19	8	24 (.31 or $\frac{1}{16}$ "), 30 (.30), 32 (.29), 36 (.29)
No. 16	9	21 (.29), 28 (.27), 30 (.27), 32 (.26)
No. 11	10	24 (.25), 30 (.21), 32 (.20)
No. 6	11	24 (.19), 28 (.18), 30 (.18)
7/32"	12	20 (.18), 22 (.17), 24 (.16), 28 (.14)
15/64"	13	20 (.14), 22 (.13), 24 (.11)
D	14	18 (.11), 20 (.9), 22 (.7), 24 (.6)
F	15	18 (.6), 20 (.4), 22 (.3), 24 (.3)
I	16	16 (.3), 18 (.3), 20 (.2), 22 (.1)
L	17	16 (.2), 18 (.1), 20 (.15/64")
19/64"	18	16 (.15/64"), 18 (C), 20 (D)
5/16"	19	16 ($\frac{1}{4}$ "), 18 (F), 20 (G)
P	20	16 (17/64"), 18 (17/64"), 20 (I)
S	22	16 (L), 18 (19/64")
3/8"	24	14 (N), 16 (5/16"), 18 (P)
13/32"	26	14 (Q), 16 (11/32")
7/16"	28	14 (23/64"), 16 (U)
29/64"	50	14 (W), 16 (X)
1/16"	1/16"	64 (3/64"), 72 (3/64")
5/64"	5/64"	60 (1/16"), 72 (.32)
3/32"	3/32"	48 (.49), 50 (.48)
7/64"	7/64"	48 (.43)
1/8"	1/8"	32 (3/32"), 40 (.38)
9/64"	9/64"	40 (.32)
5/32"	5/32"	32 ($\frac{1}{4}$ "), 36 (.30)
11/64"	11/64"	32 (9/64")
3/16"	3/16"	24 (.26), 32 (.22)
13/64"	13/64"	24 (.20)
7/32"	7/32"	24 (.16), 32 (.12)
15/64"	15/64"	24 (.10)
1/4"	1/4"	20 (.6), 24 (.4), 27 (.3), 28 (.1), 32 (7/32")
5/16"	5/16"	18 (G), 20 (17/64"), 24 (J), 17 (J), 32 (9/32")
3/8"	3/8"	16 (5/16"), 20 (21/64"), 24 (Q), 27 (R)
7/16"	7/16"	14 (U), 20 (25/64"), 24 (X), 27 (Y)
1/2"	1/2"	12 (27/64"), 13 (27/64"), 20 (29/64"), 24 (29/64")
9/16"	9/16"	12 (31/64"), 18 ($\frac{1}{2}$ ")
5/8"	5/8"	11 (17/32"), 18 (9/16")
11/16"	11/16"	16 ($\frac{3}{4}$ ")
3/4"	3/4"	10 (21/32"), 16 (11/16")
7/8"	7/8"	9 (49/64"), 14 (13/16")
1"	1"	8 ($\frac{7}{8}$ "), 14 (15/16")



has 14 threads per inch. Dividing .9 by 14 you get .064. Subtracting this from $\frac{3}{8}$ in. which in decimal numbers is .375, leaves .311, the tap-drill size. Next you consult a drill-size table such as was included in Part I of this series of articles and find that the nearest drill less than this diameter is $\frac{19}{64}$ in. The "N"-sized drill is also close enough so we may use either of these which is at hand. In the case of screws over $\frac{1}{4}$ in. in diameter, select the nearest smaller size of tap drill as figured above. For screws smaller than $\frac{1}{4}$ in., the nearest drill larger than the required size is selected. Centering a tap drill through a larger-sized body drill hole is a job which frequently causes difficulties. A simple method of accomplishing this is illustrated in Fig. 32. First a drill of the same size as the large hole is inserted to locate the center. After this the smaller tap drill will easily follow the start made by the larger drill. Countersinks and counter-bores are so much used in connection with drilling operations that Fig. 35 has been included to make clear their application in this work.

Drilling Hard Rubber and Plastics: If standard high-speed drills are used those smaller than $\frac{1}{4}$ in. should be ground to an angle of 45° rather than the standard 59° angle. Drills larger than $\frac{1}{4}$ in. should be ground as usual. Fig. 34 contains the values of speeds and feeds which have been found satisfactory for drilling these types of material. The drill should be backed out frequently to insure the removal of chips and prevent overheating.

SPEEDS AND FEEDS FOR DRILLING RUBBER AND PLASTIC MATERIALS 34

SIZE OF DRILL (DIAMETER)	SPEED (R.P.M.)	FEED IN INCHES PER REV. OF DRILL
$\frac{3}{16}$ " AND SMALLER	4000	.005
$\frac{1}{4}$ "	3000	.006
$\frac{3}{8}$ "	2000	.008
$\frac{1}{2}$ "	1550	.010
$\frac{5}{8}$ "	1200	.011
$\frac{3}{4}$ "	1000	.012
1" OR LARGER	750	.014

FLAT-HEAD MACHINE SCREW

F.H. SCREWS

FILLISTER-HEAD MACHINE SCREW

COUNTERBORE $\frac{1}{2}$ THICKNESS

COUNTER DRILL

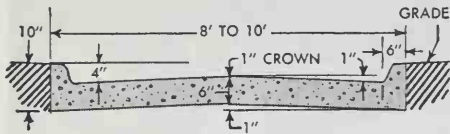
COUNTERSINKING IN THIN METAL

COUNTERSINKS FOR MACHINE SCREWS

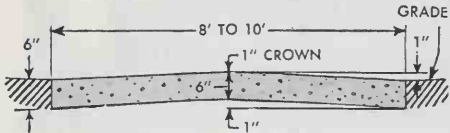
PILOT

35

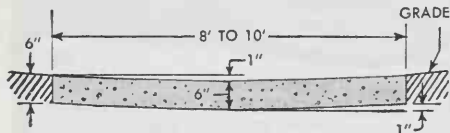
TYPICAL FULL-WIDTH DRIVEWAYS



CONVEX SURFACE WITH CURBS

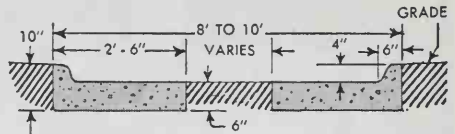


CONVEX SURFACE WITHOUT CURBS

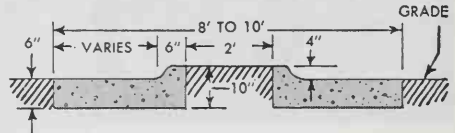


CONCAVE SURFACE WITHOUT CURBS

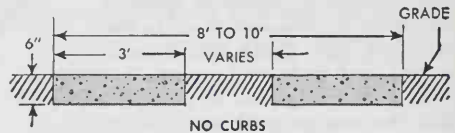
TYPICAL TWO-STRIP DRIVEWAYS



CURBS ON OUTSIDE

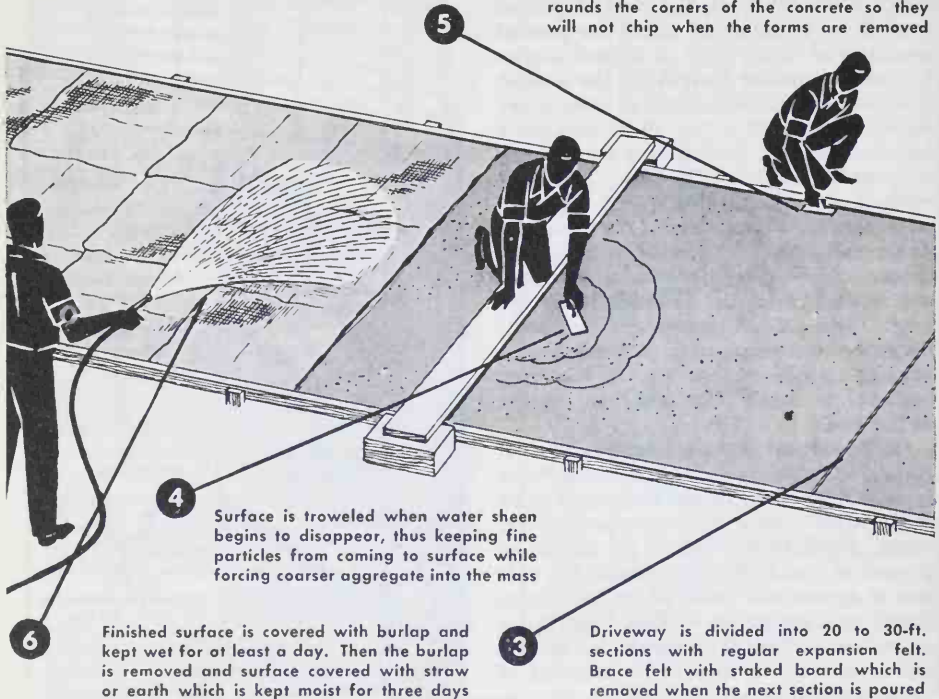


CURBS ON INSIDE



NO CURBS

An edging tool is used in the joints between the concrete and the side forms. The tool rounds the corners of the concrete so they will not chip when the forms are removed



DRIVEWAY

NOW THAT ready-mixed concrete is available in many communities, pouring a concrete driveway is no longer the herculean job that only a work horse would try. The backbreaking labor of feeding a mixer, wheeling the heavy grout and cleaning up the ensuing mess has been eliminated, thus bringing the job easily within the capabilities of the average homeowner. A ready-mix truck will back into the excavation and pour the concrete right into the forms. Because of the controlled methods of mixing, ready-mixed concrete also is likely to give you a far better job than if you had mixed it yourself.

The details at the left show typical full-width and two-strip driveways with convex or concave surfaces to assure proper drainage. The one selected should be determined by the load carried, drainage requirements and your personal preferences. If the drive is subjected to fairly heavy traffic, the full-width pavement will stand up longer. However, the two-strip driveway will prove satisfactory where only occasional usage is involved. Note that a 6-in. layer of concrete is recommended on all types. Although this thickness is not necessary for passenger cars, it is required to

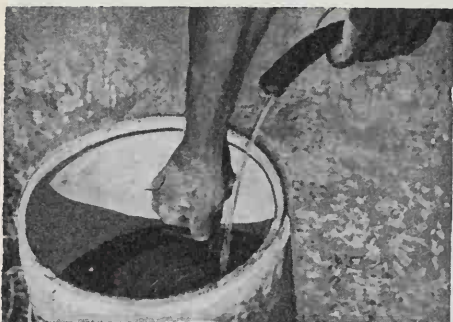


If ready-mixed service is not available in your community, your next best bet is a rented mixer. With the aid of a friend or two to keep the job moving, you won't be caught short when it comes to troweling

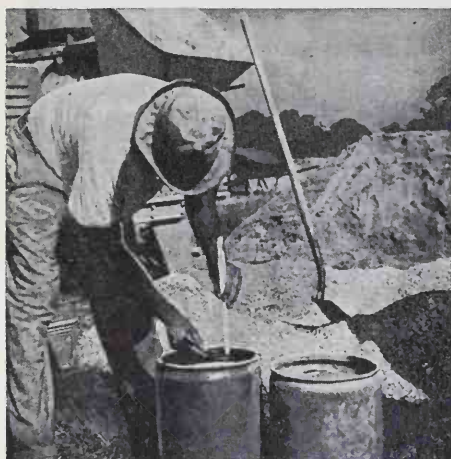
2 Next, concrete is spread evenly with a strike board which is worked sideways. The lower edge of the board is cut to form desired contour on the driveway surface

1 Ready-mixed concrete can be trucked right into your driveway forms and poured just where you want it. Worked to the top of the forms, the concrete is spaded thoroughly





In making $\frac{1}{2}$ -bag batch of 1 : $2\frac{1}{4}$: 3 mix, measure $2\frac{1}{2}$ gal. of water into pail and mark level on inside. Then pail can be refilled with garden hose, as above, for adding just the right amount of water to the mix



For $\frac{1}{2}$ -bag mixes, a bag of portland cement can be divided equally by using two pails of the same size. With a ruler, measure from the rim to the top of the cement to be sure that the level is the same in both pails. Then mark one for use as a measure

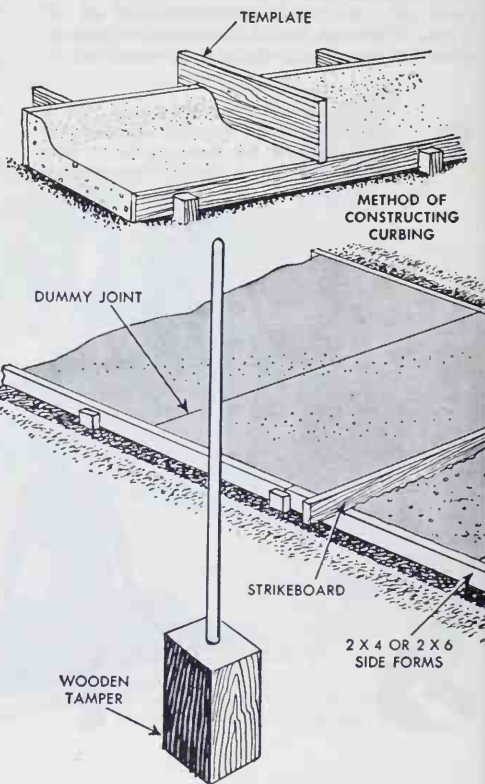


carry safely the weight of coal and other delivery trucks.

The first step in building the driveway is to stake out the proposed boundaries. Connect the stakes with string and drive the car over the route, just as you would after the driveway is poured, making any necessary adjustments in width and radius of curves. Sometimes it is easier to lay out curved driveways by driving the car over the desired path and then placing the stakes to conform with the route which was taken by the car.

The grade should be as slight as possible, as steep grades tend to be slippery and, in some cases, contribute to obstructing the driver's view of the sidewalk and street. Grades of more than 25 percent offer two additional problems. The underside of the car is likely to scrape the pavement at the top of the grade, while either the front or rear bumper of the car may scrape at the bottom of the grade. Sloping drives should be built straight, as it is difficult to handle a car down a curved incline, especially when backing.

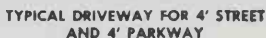
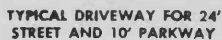
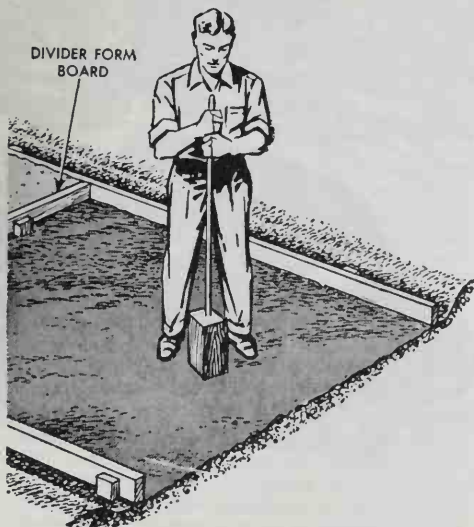
After laying out the driveway, excavate deep enough to retain a depth of at least 6 in. after tamping. To assure uniform bearing power, remove all soft, yielding material, loose rocks and boulders from the



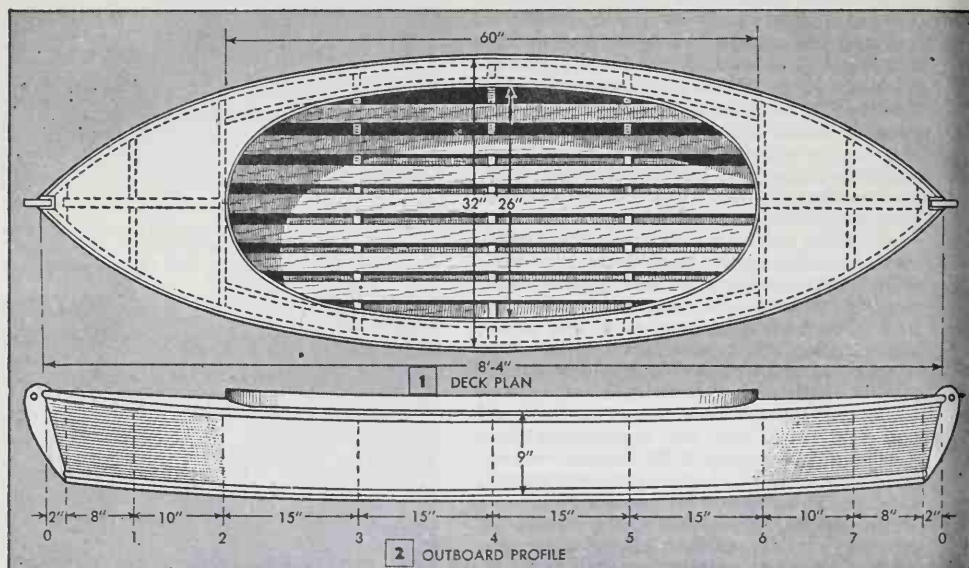
If you are unable to buy expansion felt, a similar joint can be made by placing greased boards crosswise between the side forms at 20 to 30-ft. intervals to form expansion joints. The boards are removed as soon as the concrete hardens sufficiently to retain its shape, and the openings are filled with roofing asphalt, or tar. Sand is sprinkled over the tops of the joints.

When the concrete is poured, it is spaded or tamped to assure consolidation and prevent honeycombing. As concrete usually must be poured and compacted within 30 min. after mixing in order to obtain maximum strength, it is a good idea to have two or more workers present to handle a truckload of ready-mixed concrete.

If ready-mixed service is not available and you must mix the concrete with a rented mixer, use a 1:2¼:3 mix; that is, cement, 1 part, sand, 2¼ parts, and gravel, 3 parts. To estimate the quantities of material needed, figure that 1 bag of cement contains 1 cu. ft., and that 1 ton of aggregate (gravel or sand) contains roughly 22 cu. ft. This, of course, will vary, and more accurate data can be obtained from your dealer.



DUCKBOAT

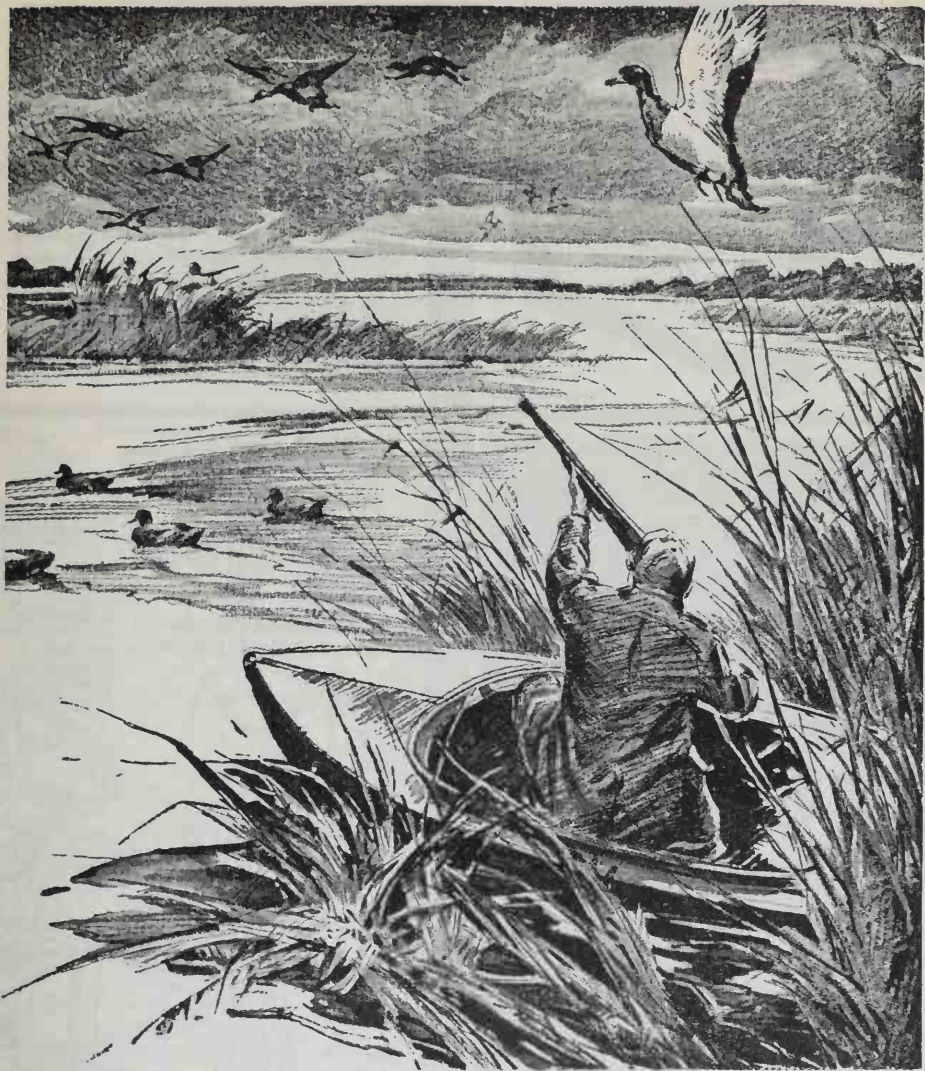


LIGHT ENOUGH to carry on a car or even on your shoulders, this boat will enable you to reach hideaways that are inaccessible with heavier craft. It is sturdy enough to push through dense weed growths and light enough to navigate the shallowest waters. Although only 8 ft. 4 in. long, Featherweight has a capacity of well over 300 pounds. Its construction of $\frac{1}{4}$ -in. waterproof plywood over light pine framing gives it the well-proportioned lines that are shown in Figs. 1 and 2.

Featherweight is built upside down on an erecting frame as shown in Fig. 8. Construction begins with the boat frames, Fig. 4. These are made of $\frac{3}{4}$ -in. (net) pine or other light wood that will not split easily. Full-size patterns drawn on heavy wrapping paper will aid in laying out the pieces to exact size and serve as a guide for assembling them after they are cut. Waterproof glue and No. 8 brass screws are used to join the parts as indicated in Fig. 3. Temporary braces are installed on the open frames 3, 4 and 5.

The strongback of the erecting frame, Fig. 11, is made from a 2 by 8-in. plank. A $\frac{7}{8}$ by $\frac{7}{8}$ -in. batten may be used to mark

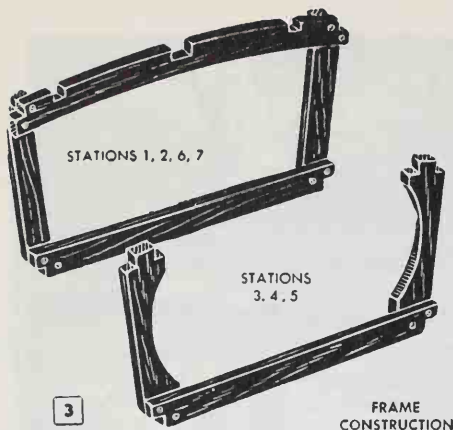




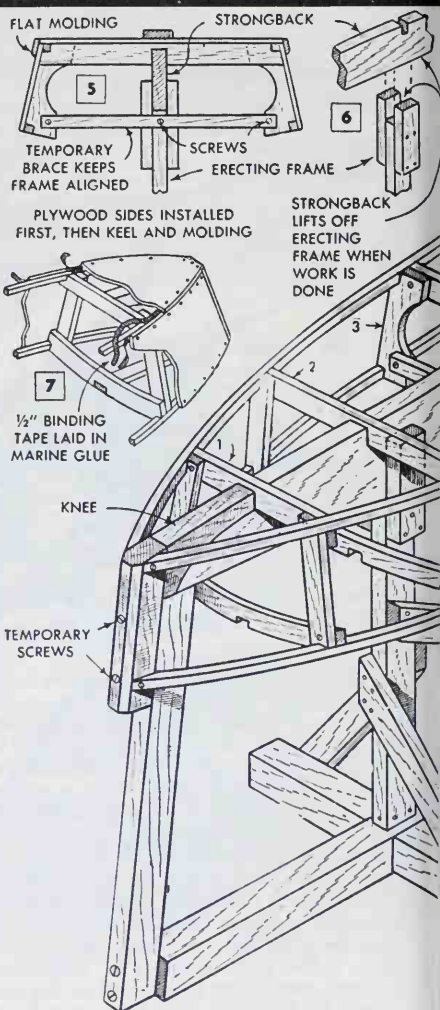
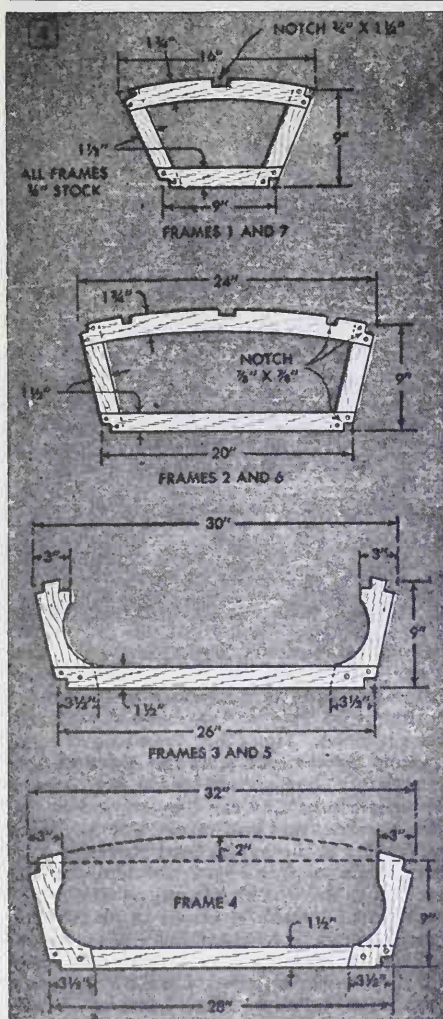
the 2-in. curve. Notches are cut to hold the boat frames in position and the ends are shaped to take a bow and stern knee as shown in Fig. 10. Almost any type of bracing on the erecting frame will be satisfactory provided it is rigid and does not interfere with the work. The framing lumber should be well seasoned so it will not warp and cause the boat to become lopsided. The perspective view, Fig. 8, shows the entire assembly in full detail. Note in Fig. 6 that the framing is built so that the strongback can be lifted off with the boat frame when the work is completed in this position. When assembling the frames on the strongback be sure the uprights, or side members of the frames, are on opposite sides of

their cross members, beginning amidships as shown in Fig. 8. The temporary brace on the No. 4 frame is screwed to the erecting frame as in Fig. 5 to keep it squared and centered. The other frames are held in place by toenailing at the sides of the strongback. Care should be taken to locate the nails where they can be removed easily after the sides and bottom are put on. With the frames in place, the boat stems, one of which is detailed in Fig. 9, are temporarily screwed to the erecting frame as in Fig. 11. Both stems should be about 12 in. long to permit trimming to exact size later.

To install the sheer battens, temporarily nail them in the notches of the No. 4 frame. Then bend the ends of the battens around



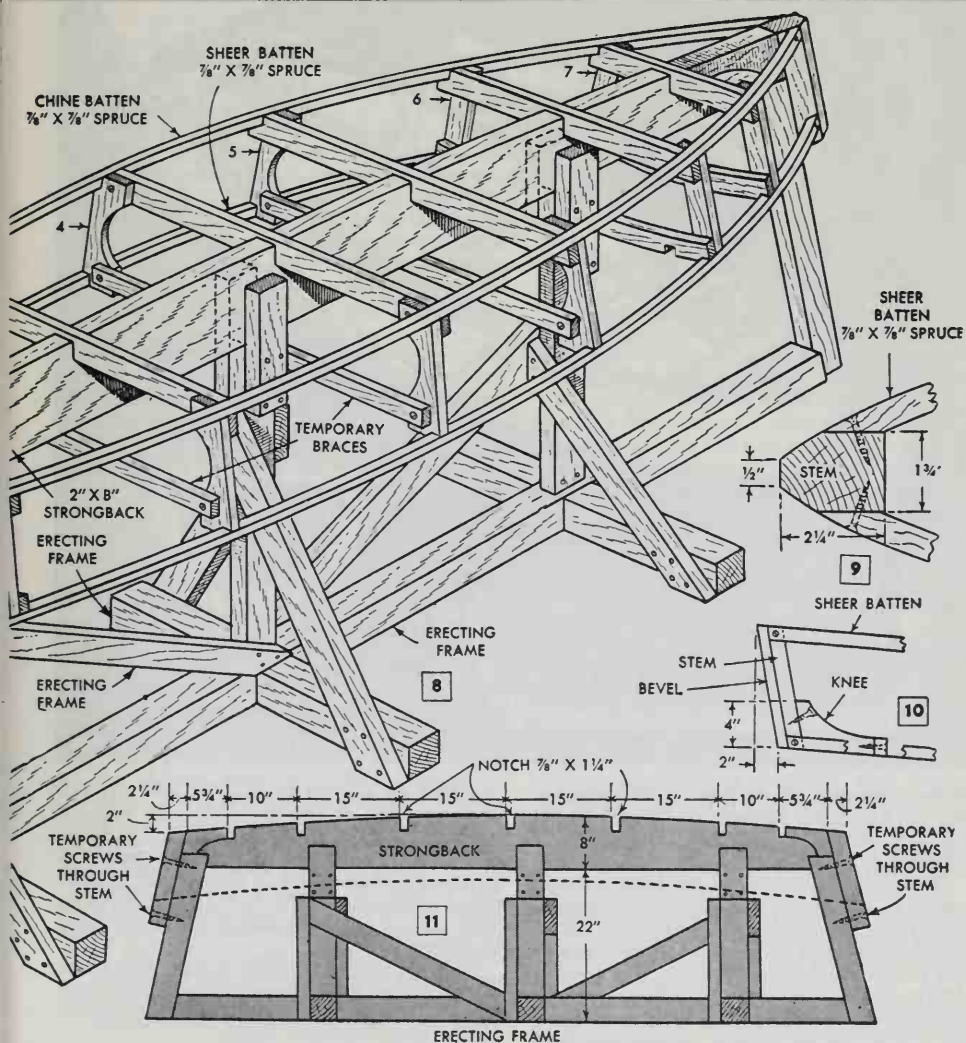
to the stems and mark so they will fit just back of the bevels as indicated in Fig. 9. After cutting to size, install the battens permanently with screws and waterproof glue. Fasten them to frame No. 4 first, and then work progressively toward the stems, securing both sides alternately. Check all the frames for squareness before fastening the sheer battens. Chine battens are installed in the same way. To assure a watertight hull, screws must be countersunk and the battens planed flush with the frames. The plywood covering must be in snug contact with the sheer and chine battens and bevels of the stems. To install the sides, bend and

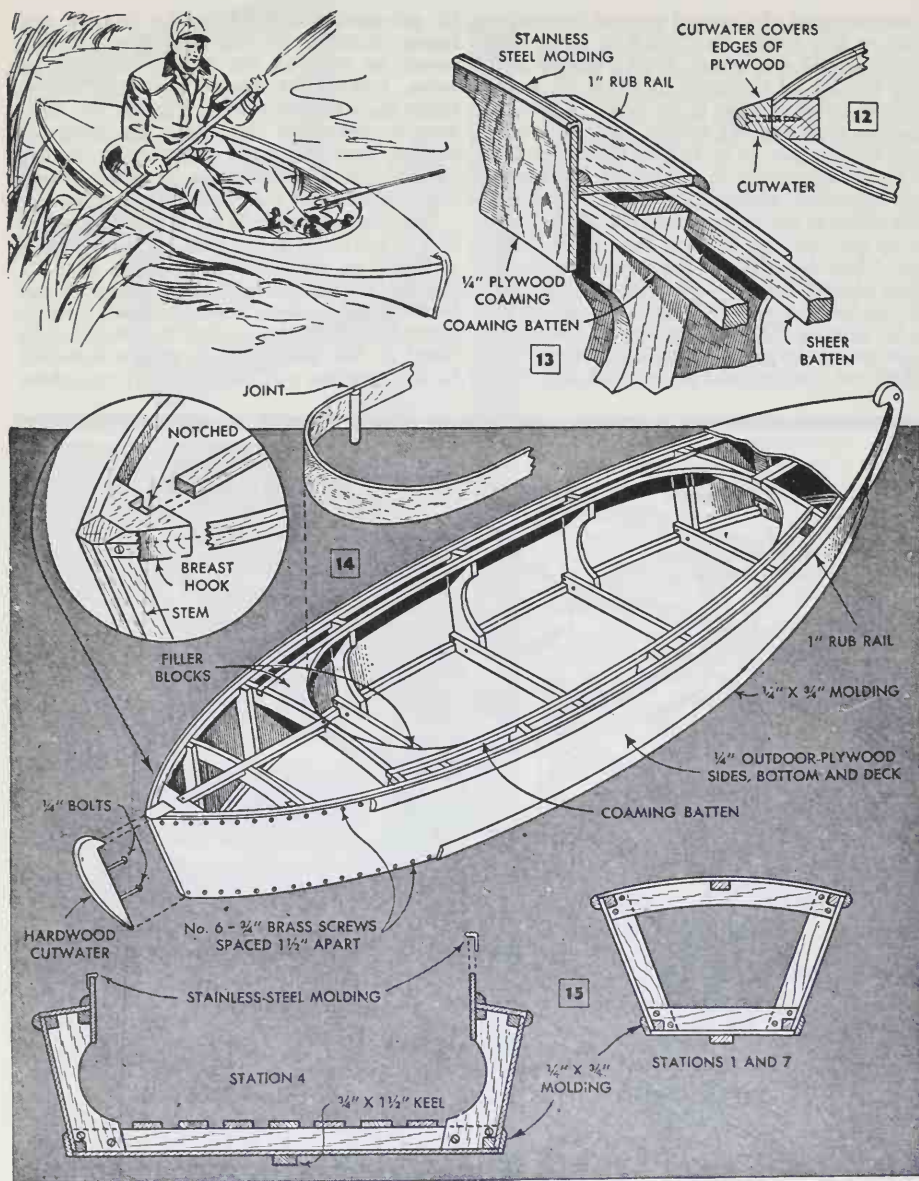


clamp a panel of plywood around the entire side of the frame and mark it along the sheer, chine and stem. Then remove and saw outside of the lines to allow for trim. Cotton binding tape $\frac{1}{2}$ in. wide is laid in marine glue applied to the battens, stems and side panels as in Fig. 7. The sides are nailed temporarily to the frame amidships and screwed alternately each way from this point to the stems. Care should be taken to prevent the binding tape from shifting. After the edges of the side pieces have been planed flush with the chine batten, lay on the bottom panel of plywood and mark it for sawing. This is installed in the same manner as the sides. With the bottom finished, set the keel and fasten with 2-in. No.

10 galvanized screws to the frames and knees. To cover the edge of the bottom plywood, as well as the screwheads in the sides, install flat, wood moldings at the chine lines as indicated in Fig. 15. The temporary screws in the stems are then removed, and the hull, together with the strongback, lifted off the erecting frame and placed right side up on sawhorses.

The strongback will have to be sawed in half to get it out of the hull. A false bottom or floor as shown at station 4, Fig. 15, should be made an individual unit so it can be removed to clean the bilge. Deck beams, extending from the cockpit to breast hooks fitted in the bow and stern, are installed in the notches cut in the upper members





of the fore and aft frames as indicated in Fig. 14. Coaming battens and filler blocks are then added to support the deck and plywood coaming around the cockpit.

The entire deck may be cut from a single panel of plywood with the cockpit area sawed out, or, if too awkward to handle in one sheet, it can be made from two pieces and joined at the No. 4 frame. Plywood is also used for the coaming, which is made in four sections and joined with a reinforcing strip at frames 3 and 5. A stainless-steel

molding as shown in Fig. 13 will protect the top edge of the coaming. To make a watertight joint with the deck, lay a quarter-round molding in marine glue and fit it as snugly as possible in the corner. Hardwood cutwaters at the bow and stern as in Fig. 12 and rub rails along the sheer lines complete the boat.

For an inconspicuous finish, paint the boat a cattail green both inside and outside. Then follow with two coats of spar varnish. Allow time between coats.

DYEING

DO YOU NEED new drapes simply because you changed the color scheme of your living room? Is a favorite dress unfit to wear in public merely because it is faded? Are your curtains dingy and drab looking? Have you tired of your old gray coat but hesitate to discard it because the material is still good?

If your answer is "Yes" to any of these questions or similar ones, why not join the millions of smart housewives who are giving new life to their home furnishings and the family wardrobe by practicing home dyeing. Surveys show that home dyeing is done in at least one out of every two homes in the United States. It must, therefore, be simple, quick, successful and economical to do.

Home dyeing no longer means long hours over steaming kettles, the muscle-straining operations of dipping and wringing, trial-by-error experiments and uncertain results. Thanks to scientific research, dyeing materials at home is an easy, quick and money-saving operation which always produces successful results as long as the manufacturer's directions are followed. Modern packaged dyes come in practically any color that a housewife could want. Practically all types of fabrics—synthetic (except for a few glass and metal fibers) as well as natural—can now be successfully dyed at home.

Reasons for dyeing. The economy angle should be enough to persuade any housewife to do her own dyeing. Not only is a package of dye inexpensive, but the value of the article dyed is immeasurably increased. Many dollars are saved by having a dress, blouse or skirt last another season. And the life of many home decoration items can be prolonged by dyeing them.

There are other reasons for dyeing. For one, new colors may be needed for faded materials. Original colors are always fast. Even when their fastness is good, frequently the fabric is even better and will outlast the original dye. This is particularly true of articles that come in contact with sun-



shine or that suffer from "gas fading" while stored in the closet or elsewhere.

Home dyeing also offers an opportunity to bring apparel colors up to date. Styles in color change frequently. The popular shade of a year ago may be outdated for the current season. The color range of modern home dyes is almost limitless, and new colors are developed to keep up with the fashion trends. Also, two or more colors can be mixed to obtain a new color.

As a result of new purchases and rearrangement of furnishings, it often happens that the color of a home decoration does not harmonize with the remainder of the room. A similar situation develops frequently with respect to wardrobe ensembles. Many women employ home dyes to obtain the harmonizing shades they need for wardrobes or home decorations. They find this method a good deal easier and much more economical than buying new things.

Economy-minded women are forever mending, patching and remodeling. They find home dyeing an effective ally of such needlework since it provides the made-over things the new color beauty and freshness they require.

During national emergencies and war, some fabrics (at times, all) become very scarce. Home-dyeing helps extend the life of pre-emergency fabrics.

What to dye: Practically every wardrobe item or home decoration made of fabric



When dyeing a knitted garment, dip several yards of yarn in the dye at the same time so that you will have an exact match when it is necessary to mend the garment. When the yarn is dry, wrap it around an empty spool and label it. Thread for sewing on buttons and making buttonholes can be treated in the same manner when dyeing or tinting a garment

lends itself to home dyeing. As pointed out previously, the nature of the fabric is no longer a problem. Many manufacturers have developed "all fabric" dyes, which can be used for any kind of fabric whether natural or synthetic. Thus guesswork about fabric textures and the bother of choosing between this or that dye for different materials are eliminated. Furthermore, a single package of all-purpose dye can be used for different fabrics. All fabrics, however, do not react uniformly to dyes. Some materials are more receptive to dyes than others. Differences in the origin and construction of fabrics are the reason.

No list of articles that women dye at home could possibly be complete. New items are always turning up and new, ingenious home-dye uses are forever being devised. However, the list below will give a fair idea of the multiplicity of articles regularly dyed or tinted in the home.

Home decorations—curtains, drapes, towels, tablecloths, napkins, table mats, table runners, dresser scarves, vanity-table skirts, bath mats, scatter rugs, shag rugs and mats, pillow slips, bedsheets, blankets, quilts, bedspreads, hooked-rug material, auto robes, crib and bassinet skirts, afghans, doilies, shoe bags, venetian-blind tape, chair pads, wash cloths, shower curtains, toilet-seat covers, lamp shades, pot holders and cushion covers.

Wearing apparel—dresses, skirts, blouses, gloves, coats, undergarments, hosiery, nightgowns, negligees, pajamas, vests, be-

rets, shirts, infants' wear, handkerchiefs, neckties, swim suits and trunks, jackets, trousers, lounge robes, sweaters, beach robes, shorts, aprons, housecoats, belts, scarves, shawls, mittens, anklets, suits, slacks, turbans, felt hats, caps, bonnets, ribbons, sarongs, play suits, collar and cuff sets, socks, children's stockings, pedal pushers and synthetic pearls.

Selection of colors: Choosing a color is, of course, the first step in home dyeing. The choice of color will depend on such factors as the current color fashion, the range of colors offered by the manufacturer and the dye color already in the article. However, there are a few facts to bear in mind when choosing a color, such as the following.

The **primary** colors are red, yellow and blue. All others stem from these. The **secondary** colors are orange, green and violet—formed by combining two primaries. Thus yellow and blue give green; blue and red produce violet, and red and yellow make orange. **Complementary** colors are those opposite each other in the color wheel, such as red and green, yellow and violet, and blue and orange. A pair of complements is made up of one primary and one secondary color. In home dyeing, therefore, the resultant color will depend upon the relationship of the new dye color to the color in the fabric to be dyed.

Any color can be dyed a shade deeper with a darker dye of the same color family provided the fabric is not unevenly faded or spotted. On the other hand, in changing to an entirely different color or in changing from a dark color to a light one, the original color must be removed. The process of taking out the old color is known as "stripping," and is explained below.

Certain light tints may be treated as white and dyed any color except a pastel. Dark colors should be redyed the same color or black unless the old color has been removed.

The resulting color is influenced by the depth of the color on the fabric and the strength of the dye solution.

Strikingly novel colors and unusual effects can be achieved in two ways—(1) by mixing two or more dye colors in solution beforehand or (2) by applying a dye color over the existing color that is not closely related to the fabric color.

Dyeing printed fabrics is feasible and often produces highly desirable color effects. The print design, which cannot be removed, will show through even when dyed black. The resultant effect will depend upon the fabric and the strength of the dye solution. Frequently a striking two-tone effect is produced. It is suggested that dark dye colors be employed on prints.

Tinting versus dyeing: There are dif-

ferences between tinting and dyeing of which the home dyer should be aware before attempting either. Dyeing requires gradual heating of the dye bath to a point just below the boil, and immersion of the article in the dye bath is for a longer period than in tinting. No gradual heating process is employed for the tinting vessel. Instead, very hot tap water is employed for the tinting vessel. The period of immersion, too, is shorter than when dyeing.

Dyeing produces fastness in color, whereas tinting does not yield a fast color in the commonly accepted meaning of the term although the color produced will usually survive several launderings. Dyeing is recommended for all dark or deep colors and for both light and dark colors where fastness of the dye color is desired. Tinting is suggested for light colors and where the desired color change is to be relatively temporary.

Preparation for dyeing: There are certain preliminary steps which must be taken before any article can be dyed. Those steps are listed below.

1. An indispensable prerequisite to effective dyeing is to have the article washed and thoroughly rinsed.
2. It is recommended that you remove all buttons, buckles and trimmings and rip out hems, pleats and linings to permit the dye to penetrate evenly through the fabric.
3. All stains should be taken out.
4. If the article is unevenly faded or spotted, the old color should be removed.
5. The dyeing vessel should be agate-ware, enamelware, monel or stainless steel. Iron, galvanized iron, aluminum and cop-

Electric-plug shell pressed over a dowel protects hands from hot solution when dyeing fabric. Rubber shell will divert any dye which may run down dowel



When using the washing machine for dyeing, clean it out periodically with a force cup to remove any large accumulations of thread and lint in the drain

per vessels should be avoided since these metals have a dulling effect on the colors.

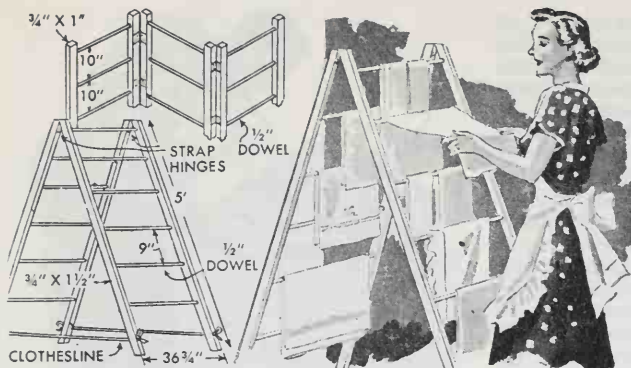
6. The vessel should be sufficiently large to hold the article without crowding.

7. The only additional equipment required is a smooth stick or wooden spoon for moving the article about in the dye bath.

8. Some dyes require the addition of salt in the dye solution; others need no "assistants." Read the directions on the package and follow them explicitly.

The dyeing process: Having performed the preliminaries, you are now ready to prepare the dye bath. At this point, however, it should be emphasized that not all packaged dyes are identical in quality, in range of colors, in trueness of colors, in effectiveness on the various types of fabric and in methods of use. It is, therefore, recommended that the manufacturer's directions be followed at all times.

The dyeing process discussed here applies only to those packaged dyes which require no boiling water. This type of dyeing is singled out because in many cases boiling is not a good practice. Many fabrics are endangered by excessively high temperatures. Since the no-boiling policy is used, the following directions can be applied to any kind of fabric. Shrinkage of woolen articles can be largely avoided by gently squeezing out excess moisture im-



Any homemaker will find either of these indoor drying racks a welcome addition to her dyeing equipment as both are simple to make and have a surprising capacity for clothes. Note the two lengths of clothesline to prevent the "stepladder" drier from spreading when open. The line is pulled through holes drilled in the legs and knotted at each end

mediately after dyeing, spreading out the article on a flat surface and pulling it into shape.

Hand dyeing: To prepare the bath for hand dyeing, stir the powdered dye in a quart of hot tap water until dissolved. The amount of dye needed will vary with the depth of color desired and with the size and weight of the article.

Warm up the dyeing vessel by rinsing it in very hot tap water. After dissolving the dye, fill the dyeing vessel with sufficient cold water to cover the article completely. Pour the dye solution into this vessel. Place the article into it *unfolded*. The article will be wet before it is put into the vessel since you have just washed and rinsed it.

Your next step is to heat the vessel gradually to a point below boiling for at least 30 min., simultaneously moving the article about freely with your smooth stick or wooden spoon. The reason for the constant motion is to allow the dye to penetrate the fabric evenly.

After heating for the allotted time, turn

Caster cups will provide handy containers for buttons and pins which must be removed from your clothes before the actual dyeing process is started



off the heat and allow to cool until lukewarm; during this cooling period continue to move the article about. Then remove the article and rinse in cool water until the rinsings are clear. The dyeing process is completed at this point.

The method of ironing will depend on the fabric. Employ the method customary for the type of material you have. Wrapping the article in a towel is recommended where damp ironing is needed.

A question frequently asked is how to determine the depth of shade you will get. Since the dyed article always looks darker when wet, it is recommended that a small piece of the material be cut from the seam, then dyed and ironed dry on the wrong side. If this test shows a need for greater depth of color, simply add more dye to the solution.

Tinting: The same process is used in tinting except that you eliminate the heating process completely and the article is immersed in the solution for a shorter period. As in dyeing, you dissolve the tint powder in a quart jar containing hot tap water. Fill the tinting vessel with very hot water—enough to cover the article completely and pour the tint solution into it. Place the unfolded article into the vessel and move it about with your wooden stick or spoon until the desired shade is obtained. Repeat the foregoing with additional tint if greater depth of color is desired. Rinse off excess tint with cool water. Gently squeeze out most of the water and iron while still damp.

Dyeing in washing machines: The washing machine, the automatic type as well as the wringer variety, is ideal for dyeing or tinting such bulky articles as bedspreads, sheets and pillow cases, slip covers, curtains, drapes, tablecloths, shag rugs and bath mats.

The amount of dye you will need is determined by the weight of the article to be dyed, so you must first weigh the article



Dyeing clothes is done more easily by using an old curling iron which can be gripped easily while stirring the fabric

while it is dry. When dyeing in a washing machine, it is recommended that the article or articles weigh no more than $4\frac{1}{2}$ lbs. when dry. Table 1, prepared by the Tintex Home Economics Bureau, suggests the amount of dye to be used according to the weight of the article to be dyed. The amounts of dye designated in the table are for cotton, linen, silk and viscose rayon. Also see Table 2, which gives average dry weights of typical articles dyed in washing machines.

All household dyes employed in washers require more dye for the dark colors. Therefore, use up to twice the amounts of dye indicated when dyeing dark colors. If the article is made of acetate rayon or nylon, use a little extra dye for the light colors and up to three times the amounts in the table for the very darkest colors. If you are dyeing *any* fabric black, use three times the amount.

The article to be dyed should always be first washed and thoroughly rinsed. For the dye bath, use the hottest water available in your machine, as the hotter the water the better will be the dyeing job and the better will be the color development. If you are using an automatic machine, warm up the inside of it before dyeing by running very hot water into the machine and allowing it to operate for several minutes. Then drain this water and immediately place in the unfolded article and allow the machine to fill up with hot water. While the machine is filling, dissolve the necessary amount of dye in very hot tap water. Then pour the dye solution into the washing machine, making sure that the article is first completely covered by water so that you do not pour the dye solution directly on the article.

Now let the washing machine operate through the regular washing cycle, or longer, if possible, to develop full color or the shade desired. Then set the machine to the last rinse. After the machine has



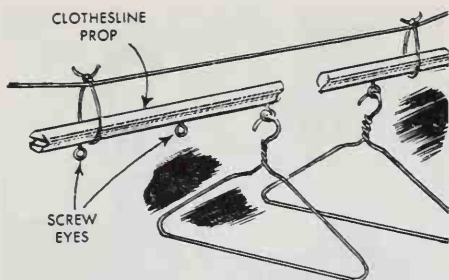
Home dye for staining unpainted furniture is one of the more recent dyeing discoveries. Big advantage is the ease of application and the low cost

completed the rinse, either spin-dry or remove the dyed article from the machine and squeeze out the excess water. Do not wring it or run it through a wringer. Hang to dry either indoors or in a shady place outdoors.

To dye in a wringer-type washer, fill the machine with the hottest water available to a height that will completely cover the article without crowding. After dissolving the necessary amount of dye in a quart jar or pitcher, pour the solution into the washing machine. Stir and then put the article to be dyed into the machine. Turn on the machine. From time to time, you will have to stop the machine to see if the article has been dyed to the depth of color you desire. When the right color has been obtained, rinse the article thoroughly. As cautioned before, do not send the dyed article through the wringer.

If at any time during the dyeing operation any dye solution splashes on the outside of your machine, wash it off with very hot water and soap or with some non-scratching cleansing powder. Immediately following the dyeing, fill your machine with clean hot water and allow it to operate on the last rinse in the automatic machine, or for a short time in the wringer-washing machine, using a small amount of soap.

There are some "don'ts" connected with washing-machine dyeing. For one thing, it



This hanger rack made from clothesline prop will keep garments aired on wire hangers from sliding together. Screw eyes driven into sides of prop receive the hanger hooks. Rack is tied to clothesline

is best not to dye woolens in the washing machine as the action of the machine may mat the fibers. Also, do not use color remover in a washer, as the large amount of water needed to operate the machine dilutes and weakens the action of the color remover. Blueing, however, may be used in a machine to whiten nylons, silks, rayons, linens, wools or cottons which have become tinged with age.

Removing the color: A fabric should be "stripped" of old color when a lighter shade is desired on a dark-colored material; when an entirely new or different color is desired for an article, and when an article is unevenly faded, stained or spotted to a great degree.

Although many packaged color removers will take the original color from most fabrics, complete elimination of the old color

is not essential to prepare the article for redyeing. It is recommended that color remover be used only in well-ventilated rooms. The primary use of color remover is to remove sufficient color from dark-colored fabrics so they can be redyed a new, light hue.

No boiling is required nor recommended when removing the old color. Put the article, after washing and rinsing, into a water-filled vessel large enough to accommodate the article without crowding. Heat to a point below boiling. Then pour color-remover powder into the vessel, moving and turning the article about for 2 to 10 min. Finally, it is essential that the article be removed and rinsed in cool water just when the color is sufficiently removed. It will then be ready for redyeing in any shade.



If you would rather dry a freshly dyed sweater in the sun, it can be hung outside on a line without stretching out of shape if it is suspended with a clean towel passed through the arm holes and held by clothespins in the three places indicated in the above illustration

Certain photos and information courtesy of
Tintex Home Economics Bureau

CHART 1 — Amount of Dye Needed for Various Weights

Weight of Article	Dye Quantity
12 oz. or less	2 oz.
18 oz. (1 lb., 2 oz.)	3 oz.
24 oz. (1½ lbs.)	4 oz.
30 oz. (1 lb., 14 oz.)	4½ oz.
36 oz. (2 lbs., 4 oz.)	5 oz.

CHART 2 — Average Dry Weights of Typical Articles Dyed in Washing Machine

Article	Weight	Article	Weight
Blouse (nylon)	4 oz.	Man's slacks (cotton)	1 lb.
Blouse (cotton)	8 oz.	Man's shirt	6 oz.
Chair slipcover	1 lb., 14 oz.	Pillowcase	4 oz.
Chenille bedspread	3 lb., 12 oz.	Sheets, double-bed	1 lb., 8 oz.
Curtains, pair	8 oz.	Sheets, single-bed	1 lb., 4 oz.
Draperies, pair (medium weight)	1 lb., 8 oz.	Woman's dress	13 oz.
Draperies, pair (heavy weight)	3 lb., 2 oz.	Woman's slacks	1 lb.
		Luncheon cloth and 8 napkins	1 lb., 4 oz.

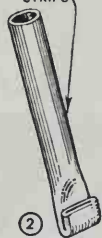
DYEING PLASTICS

DYES for plastics can be obtained in all colors and are a useful aid to the craftsman seeking decorative effects. The actual job of dyeing is simple—just dip the plastic, let it soak from 1 to 5 minutes, depending on depth of color desired, and then rinse in running water. Although the dye is a surface coat, it bonds perfectly.

The dye vat can be any kind of tall can or a glass tumbler. A metal tube, flattened as in Fig. 2, is useful for dipping long strips. A coarse metal screen, Fig. 1, keeps the plastic clear of the container bottom. Dyes can be rebottled and used repeatedly. However, the dye evaporates very quickly in an open dish. Keep it away from an open flame when using.

Although over-all colors are the most practical, it is possible to obtain two-tone effects by masking. Fig. 3 shows a plastic square masked by dragging liquid glue across it to form a pattern. After dyeing, the glue

FLATTENED TUBE FOR DIPPING STRIPS



washes off in the water rinse, exposing the pattern as in Fig. 4. Silhouettes and straight lines can be similarly worked, thinning the glue as needed. Paper masking tapes are not suitable as the dye seeps under the edges. A special masking tape is available which is designed to avoid this fault.

Dyes are easily made as in Figs. 5, 6 and 7. Just use a dry-powder stain soluble in oil, the same product that is used in making wood stains. Mahogany makes a nice red; walnut a clear yellow. If prepared plastic dyes are used, they should be straight colors: oil red, oil blue, oil green, etc. Excess stain and impurities are fil-



MIX ACETONE AND WATER



ADD POWDER-FORM OIL STAIN



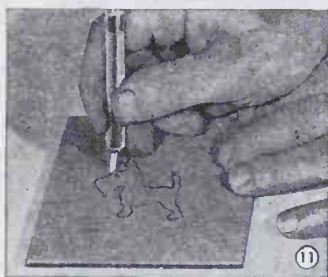
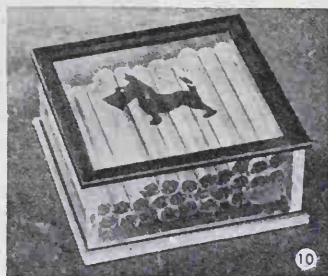
FILTER THE MIXTURE



Laminating dyes make colorful mottles

tered out, Fig. 7. Most drugstores carry filter paper and acetone.

Laminating dyes are made by dissolving a few shavings of thermoplastic in 1C cement which is used in cementing this "glass" product. Then add oil stain for color. This product cements and dyes in one operation and is particularly good for mottles as shown in Fig. 8. The various colors should be streaked on with a matchstick, Fig. 9. They probably will dry before the job is complete, but are redissolved by quickly applying a generous portion of clear cement— heavy type with shavings



Dye inlays are attractive

added—to the center of the work, after which the top piece is pressed in place. Squeeze gently to spread the cement and force out air bubbles. If clamping pressure is used it should be very light.

Dye inlays can be worked with plain dye by using a glue mask as already described, or by using the laminating dye. The latter can be masked off to a sharp, clean edge. Finished inlay, Fig. 10, is perfectly bonded. The original paper cover on plastic can be used as a mask, cutting out the desired figure with a stencil knife, Fig. 11. Colored dye-cement must be applied by flow-coating, as shown in Fig. 12. It is impossible to spray or brush the material because of rapid drying. Thus applied, the design will be translucent and will have a gloss equal to the plastic.

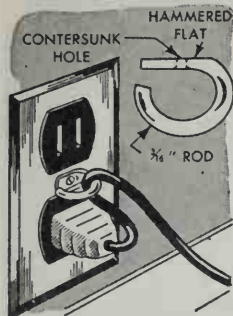
Concentrated dyes which can be mixed with 8 to 12 parts of water are available and are useful for certain types of work. Application requires heating the dye bath to about

190 deg. and then immersing the work for 1 to 5 min., depending on depth of color desired. However, heat of the dye bath tends to warp the plastic. For most craftwork the chemical dyes are preferable.

In general, work to be dyed can be colored before or after assembly. If dyed before assembly, the pieces should be cut to net size. If any color effect is unsatisfactory, remove it by using a clear dip of acetone and water. Similarly, if a two-tone effect is wanted, the piece can be dyed one color all over, then dipped in a second color which will strip the first coat and deposit the second on exposed areas. An instant dip and rinse will color sanded edges.

ELECTRIC APPLIANCE CORDS

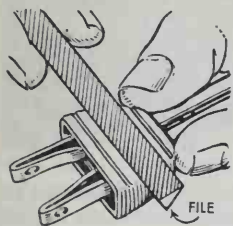
Metal Loop on Receptacle Plate Snubs Appliance Cord



Attached to the plate of a wall receptacle, this metal loop anchors the plug of a portable tool or vacuum cleaner so that it is not pulled from the receptacle whenever the slightest tension is exerted on the cord. The loop is bent from $\frac{1}{4}$ -in. rod, one end being

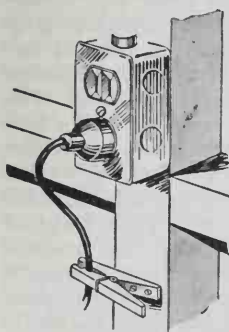
flattened and drilled to receive the mounting screw of the receptacle plate. The hole is countersunk for the head of the screw. Note that the space between the ends of the loop must be sufficient to permit passage of the appliance cord. If necessary, extension cords from both outlets can be snubbed simultaneously with the metal loop.

Grooves Filed in Electric Plug Provide Firm Finger Grip



the plug as indicated, a surface that can be gripped firmly is provided.

Clothespin Keeps Electric Cord In Wall Outlet



clothespin will hold the cord securely and resist (up to a certain point) any tension

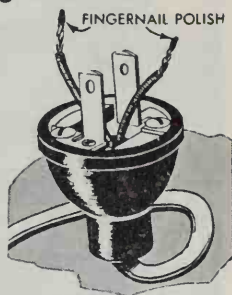
The annoyance of having an electric cord pull out or work loose in a wall outlet while operating a tool such as a soldering iron or an electric drill can be prevented with a spring-type clothespin. Mounted on the wall several inches below the outlet, the

placed upon it. A little slack in the cord between the socket and the clothespin will facilitate the removal of the cord when it is necessary to do so.

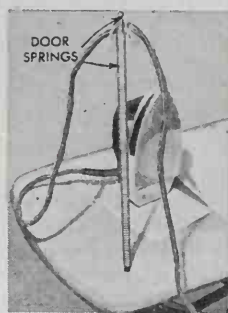
Electric Wires Kept From Fraying By Applying Fingernail Polish

When connecting the bared ends of electric wires, such as lamp cords, to the terminals of a plug or outlet, the wire, even though twisted, tends to fray when the screws are tightened. To prevent fraying and assure good contact, twist the ends

of the wires and apply a drop of fingernail polish to the extreme tip of each one to hold the strands in place. Application of a little fingernail polish also will prevent fraying of the silk covering where it has been cut away from the insulation.



Spring Supports Electric-Iron Cord



Two screen-door springs, one of which will fit inside the other to provide rigidity, will make an inexpensive support for an electric-iron cord. After the smaller spring has been slipped inside the larger, one end is fastened to the board or convenient place on a

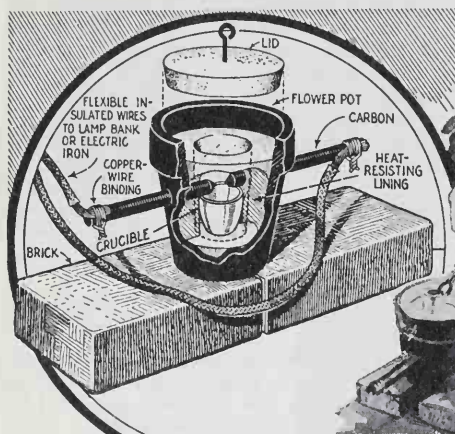
near-by wall and the other is tied to the cord, allowing enough slack in the cord for free movement of the iron.

Holder for Slack in Electric Cord

Slack in electric cord is wound and held in a useful device made from a $\frac{1}{8} \times 1 \times 6$ -in. length of cardboard. Drill a $\frac{3}{16}$ -in. hole $\frac{1}{2}$ in. from each end and cut a slot from each hole to the end of the board. Surplus cord is wound on the holder and slipped through the slots.



ELECTRIC-ARC FURNACE



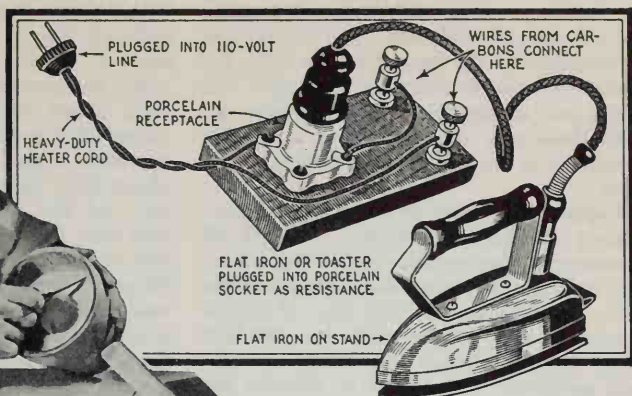
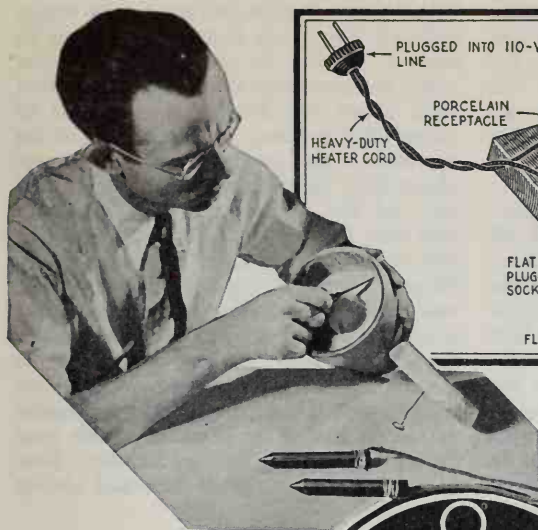
*to melt metals
and make alloys*



WHERE high temperatures are needed for melting small quantities of metals, making alloys, or performing chemical experiments requiring intense heat, a small electric-arc furnace, which is easy to make and costs little, will often be found indispensable in the home workshop or laboratory. It is built in a flowerpot, as shown above. Holes for two electric arc-light carbons are cut into opposite sides of the pot about three-fourths of the height of the pot above the bottom. The holes should be just a fraction larger in diameter than the carbons. They are best made by slowly drilling through with a small drill, after which they can then be carefully reamed to the proper size with a coarse rat-tail file.

A good refractory lining for this furnace is made by mixing while dry, equal parts of fire clay and ground asbestos. This filling material is worked to a thick, even, putty-like cement with a small quan-

tity of water glass. Only the amounts to be immediately used should be made up, as when allowed to stand, this cement gets stone hard and becomes useless. The bottom of the flowerpot is covered with the refractory cement to a depth of about 1½ in. It should be pressed firmly in place and tamped level and even with a flat-ended stick. A smooth drinking glass whose sides taper slightly is now set upright in the center of this bottom lining to serve as a mold for the side lining. The arc carbons are next wrapped with a layer of asbestos paper, which may be secured in place with a short length of thread. They are then inserted through the holes in the pot and their ends pushed square against the drinking glass. The asbestos is used to prevent cement from sticking to the carbons and thus making it impossible to remove them, after the lining has hardened. The space between the glass and



the pot is next filled to within $1\frac{1}{2}$ in. of the top with the lining cement. It should be applied in small quantities, packing thoroughly to eliminate air pockets. The drinking glass should be carefully removed immediately after the packing is complete, otherwise it may permanently stick to the cement and have to be broken away after the lining has hardened. If the glass is to be saved it should be immediately washed in water to remove the water glass. The carbons should next be carefully turned in their asbestos wrappers to make certain that they are not stuck. They should not be removed, however, until the lining has dried for a couple of days. The lining may be dried out in an oven in about 5 hrs., although a better job will be had if it is allowed to dry in the air for a week.

To make a lid for the furnace, get a round cardboard carton of the same diameter as the inside of the flowerpot, and cut it to a depth of about 2 in. to serve as a mold. Before pressing cement into the box a piece of stiff iron wire is bent to the form of an eye at one end. The other end should be buried in the cement cover so that only the eye projects to serve as a



handle for removing the cover from the furnace with a pair of tongs. The cover should be allowed to dry in the mold and the cardboard is torn away after the cement has hardened.

When the lining has dried the carbons may be removed. A 3-ft. length of heavy-duty heater cord is connected to each carbon at its unpointed end. The strands of fine wire in the heater cord may be held in good contact with the carbons by

binding with wire as shown, or if a more permanent job is wanted, brass clamps may be made to hold the wires. The other ends of these wires are connected to the binding posts on a small block as shown. An electric-arc furnace cannot be connected directly across the lighting circuit without blowing fuses, so the family electric flatiron comes into play as a limiting resistance. The iron is plugged into the socket also mounted on the board. With this arrangement the iron is connected in series with the carbons. To start the arc, push the carbons together with their points about in the center of the furnace. This should be done with a pair of pliers having taped handles to avoid shock and burns after the furnace has been running for a few minutes. After the carbons have been in contact for a few seconds they will become hot on the ends, and then one of them may be carefully pulled away

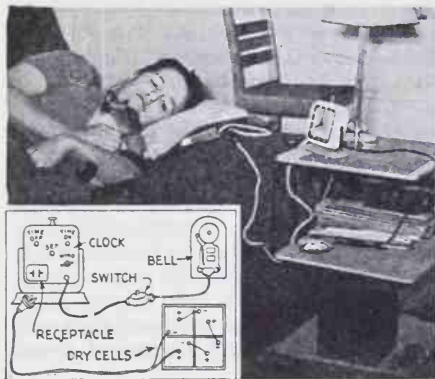
from the other for a distance of about $\frac{1}{4}$ in. A little practice will enable you to draw an arc without difficulty. The cored-type of carbons are the easiest to use. The arc should not be viewed with the naked eye but a pair of goggles should be worn and with these you will be enabled to see the condition of the arc without danger to the eyes.

Copper wires held in the arc are immediately melted and burned. Almost all common substances undergo similar chemical change when they are exposed to the high temperature of the arc. If a few scraps of fine copper wire are cut into short lengths, placed in a small crucible and sprinkled with borax to prevent the formation of the black powder, or copper oxide, which was formed when the wire was held directly in the arc, they may be melted in 10 or 15 minutes. The lid should be kept on during the melting of copper

as a great amount of heat will be required. The copper will glow red and finally white, and you may think that it is not going to melt at all, but do not give up, for the wires will presently and unexpectedly lose their shape and form a molten pool of mirror-like brilliancy in the bottom of the crucible. If you add to the molten copper about half its weight of zinc and then turn off the arc, the zinc will melt and mix with the copper to form the common but very valuable alloy known as brass. Brasses have varying proportions of zinc and copper, depending upon their purposes. Similarly, if tin is added to molten copper an alloy known as bronze is formed. There are hundreds of interesting and valuable experiments in this magic of metals known as alloying, which may be performed with this arc furnace. New alloys are discovered or invented almost every day.

Bell Controlled by Electric Clock

If you are hard of hearing or sleep so soundly that the regular alarm clock does not awaken you, this bell-and-clock hook-up will solve your problem. It consists of a clock of the type used to turn on or off electrical appliances in the home, and a bell or buzzer, the latter being placed under the pillow of the sleeper. Four dry cells or a bell-ringing transformer are plugged into the receptacle of the clock and the bell connected to the appliance outlet. A switch is put in the bell line to shut it off.



Lubricating an Electric Clock

An excessively noisy electric-clock motor usually indicates a lack of oil, which can be applied to most motors without opening the case. To do this turn the motor so that the exposed pinion is at the top and, while warming it with the heat of a 60-watt bulb, apply a few drops of light household oil to the pinion. During the operation small bubbles will appear. As soon as the bubbling ceases remove the heat but continue to apply oil that will be drawn in around the pinion as the motor cools.





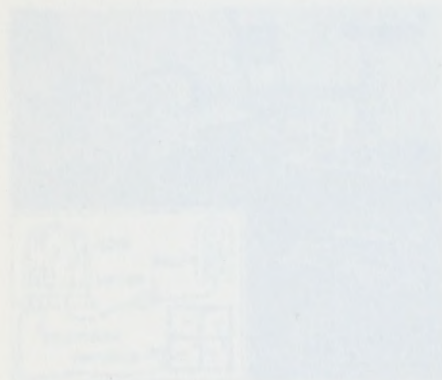
from the filter for a distance of about 10 in. It leaks readily with considerable flow at any without difficulty. The advantages of coppers are too many to list. They are smooth and do not rust, the metal can be a pair of glasses against the water and with care you will be enabled to use the condition of the eye without danger to the eye.

Copper is not held to that any one person during travel and travel. Almost all common substances change their chemical change when they are exposed to the high temperature of the sun. It is a few inches of fine copper wire are one inch short length, placed in a small crucible and surrounded with wood to prevent the leakage of the black powder, or other acids, which are formed when the wire was held directly in the sun. They may be sealed in that is nature. The lid should be kept on during the setting of copper

in a great amount of heat and the weather. The copper will glow and melt freely, when and you may think that it is not possible to melt at all, but it does glow red, for the wire will gradually and homogeneously change shape and form, it shows good nature, like the change in the history of the world. It was said in the copper wire, about half the weight of steel and half, top off the sun, the wire will melt, and with the copper to form the metal, but very valuable, after known as copper. However, some samples of copper of a small copper, depending upon their purity. Similarly, if you are able to melt copper on clay, better, or better, or better. There are hundreds of interesting and valuable experiments. The most of which known as a metal, which may be perfected with the art of science. The above are the names of a metal after the sun.

Bell Controlled by Electric Clock Asleep Sound Sleeper

If you are tired of hearing or sleep or awake, that the regular electric clock does not wake you, the bell and clock both will wake you. It consists of a small of the type used to turn on or off electrical appliances in the house, and a bell or buzzer, the bell being placed under the pillow of the sleeper. First the wire or a bell-ringing transformer are placed into the receptacle of the clock and the bell connected to the appliance outlet. A switch is put in the bell line in the circuit.



Lubricating an Electric Clock

An extremely important part of oil, which can be applied to most surfaces without spoiling the same. To do this turn the motor on and the exposed portion of the fly wheel, which is running it with the most of a 10 cent hour, apply a few drops of light kerosene oil to the spring. During the operation of the motor, it will appear. As soon as the oil starts, swing around the hand and continue to apply it, that will be done in about the place as the motor starts.



